SEPTEMBER
1960

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SIXTH ANNUAL STATISTICAL REPORT

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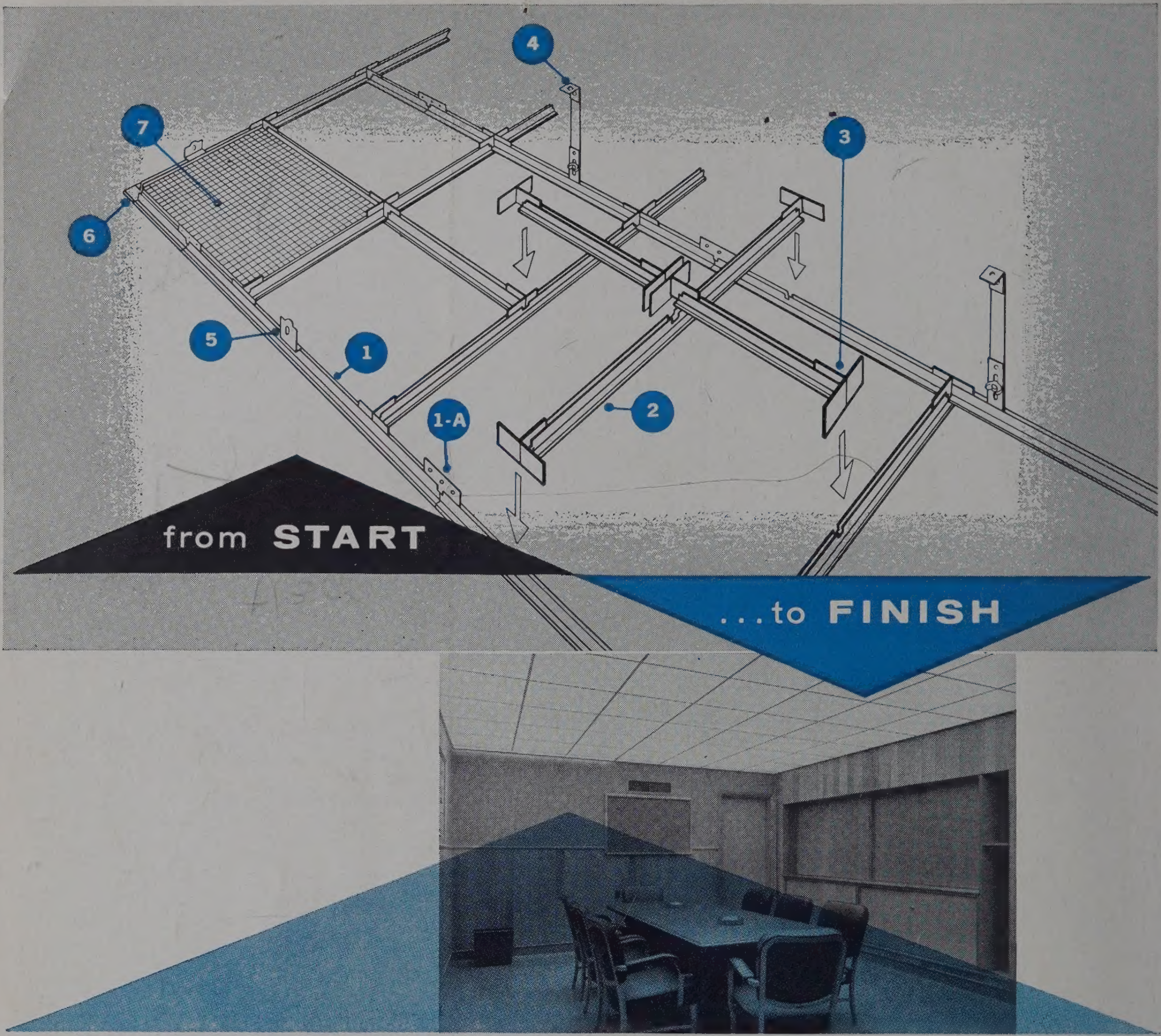

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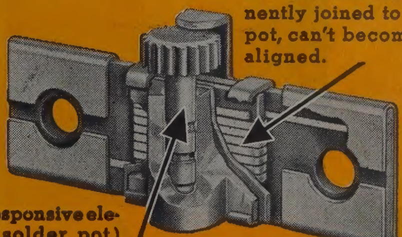

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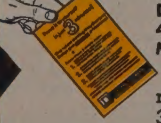

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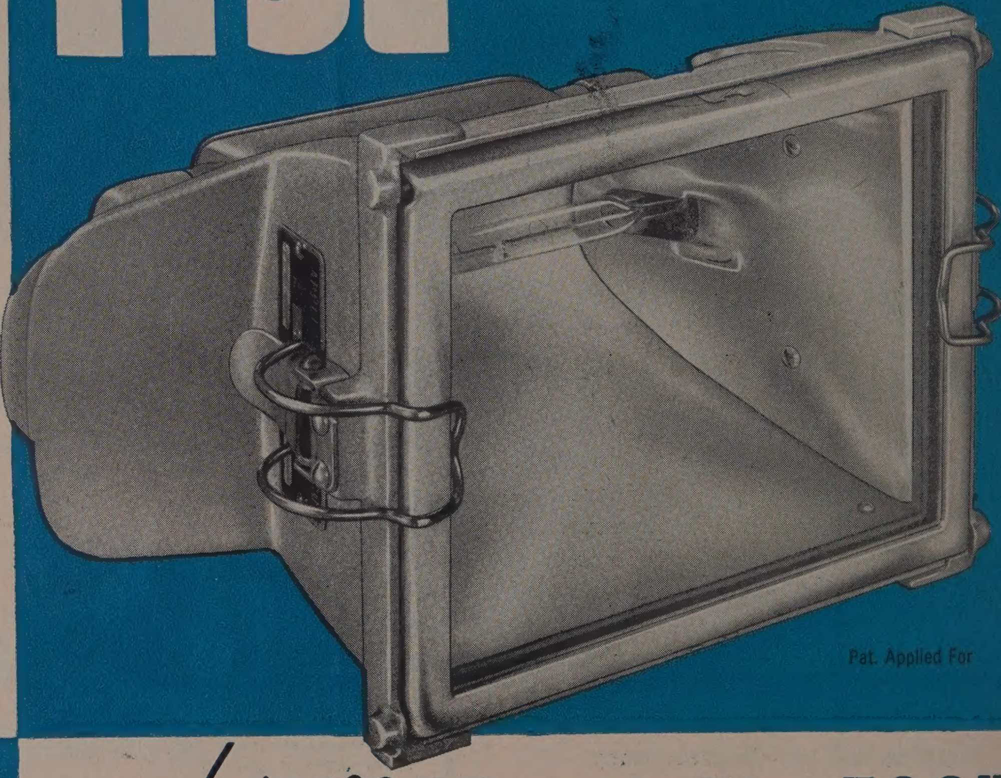

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59TH YEAR • SEPTEMBER 1960

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Low-Voltage for Pools, *An Editorial* 87

Sixth Annual Statistical Report 89

By B. C. COOPER—A growing national economy, prospect of a record year in building construction, and continuing progress in electrical equipment designs, standards, and technology all point to continued electrical growth and progress in the year ahead.

Voltage Drop in Apartment Houses 102

By FREDERICK LATZER—Design limitation of voltage drop in circuits can add substantially in increased copper, raceway and labor costs of the overall system. For this reason, permissible voltage drop in any system should be realistically related to the voltage characteristics of load devices supplied. Here's a close look at voltage drop in terms of efficiency vs economics for apartment house wiring.

Estimating Forum—IV 107

By RAY ASHLEY—Project type and risk affect job selection.

Luminous Dome Solves Glare Problem 108

Smith Electric Co. of San Francisco designed and installed a unique skylight installation; using coupled fluorescent strip-lights, messenger-cable suspension, sliding relamping techniques and aluminum canopy in confined attic space where accessibility was difficult.

How to Compute Conductor Fill in Raceways 110

By J. H. WATT—With the 1959 NEC permitting more than nine conductors in conduits, the possibility of different sizes of conductors occupying the same raceway has been greatly increased. New tables are offered to simplify calculations for estimators and designers who must determine raceway sizes in combinations not shown in present NEC tables. Examples are given to explain the application of the tables and a general discussion follows.

Electric Heating Forum No. 3 114

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ELECTRICAL CONSTRUCTION AND MAINTENANCE

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By NELSON RISCH—How to build an economical, practical deep freeze unit for small shop or laboratory use.

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Sidelights

STATISTICAL SUMMARY

In spite of the traditional economic uncertainties that crop up in presidential election years, the present and foreseeable future for the electrical industry shapes up to a conservatively optimistic outlook. There is a good prospect that 1960 will be a record year for construction and consequently for related electrical work. The current trends in the national economy, industry and electrical activity are reported by Associate Editor Berlon C. Cooper in our annual statistical summary.

VOLTAGE DROP

Arbitrary voltage drop limitations applied at full design loads often add substantially to costs. Some of the resulting increase in copper and related components may prove to be unnecessary if system performance is realistically related to the voltage characteristics required for the loads supplied. Frederick Latzer, Consulting Engineer of New York, N. Y., discusses the practical aspects of voltage drop considerations in apartment buildings from extensive experience in his article on page 102.

CONDUIT FILL

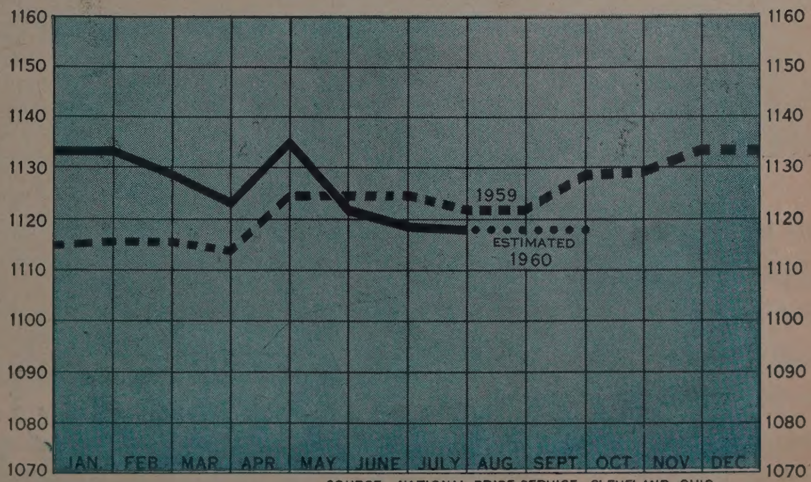
With the 1959 NEC permitting more than nine conductors in a conduit, the probability of conductors of different sizes occupying the same raceway has been greatly increased. Individual calculations are laborious and guesswork can be costly. To simplify calculation for the estimator and engineer who must determine raceway sizes for conductor combination not shown in NEC tables, Associate Editor John H. Watt has prepared tables by means of which raceway sizes can be found by simple addition. These handy tables are presented and described in "How to compute . . . Conductor Fill in Raceways" beginning on page 110.

CHANGING THE CODE

Relatively few engineers and contractors who live with the National Electrical Code daily realize that they can influence or inspire changes and improvements. Even with a legitimate beef, where this practical field experience with code applications and interpretations could be most valuable, they often remain silent because they don't know the procedures. In the interests of a better code, more practical, experienced, experts should speak when they have a constructive contribution to make. How? Read "How You Can Help to Improve the NEC," page 213.

ELECTRICAL MATERIALS COST INDEX

BASE LINE (1000) REPRESENTS COSTS OF TYPICAL ASSORTMENT OF MATERIALS FOR A SELECTED JOB AS OF NOVEMBER 1, 1951. INDEX POINTS REPRESENT THE VARIATION OF THESE SAME MATERIAL COSTS AS OF THE FIRST OF EACH MONTH.



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Washington Report

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A possible economic decline has been prevented, in part, by record spending for nondurable goods by consumers. Also, exports have risen, and government has spent a little more, primarily at the state and local level. Thus the consumer is, in essence, generating the activity that creates the income for his spending.

Personal income hit a new peak in July, at an annual rate of $407.1 billion. This was a billion dollars higher (annual rate) than in June, and an increase of $20.2 billion (annual rate) over July 1959. The rate of gain, on a month-to-month basis, is declining. The July rise stemmed primarily from a congressionally-approved pay increase for Federal employees, and from larger building industry payrolls.

Industrial output remained steady in July, at an FRB Index of 109 (1957 = 100), up only one point from July 1959. Production in August is expected to change very little, if any, but in September a slight upturn is predicted.

Growth of the national economy will be much discussed during the current Presidential campaign, as both the Democratic and the Republican nominees agree on the need for accelerated growth of the economy. Such growth is considered essential (a) to provide the resources for the long struggle with Communism, and (b) to deal with growing economic and social domestic problems which stem from population growth, rapidly increasing numbers of aged people, surging growth of the labor force, urban decay and wasting natural resources, and technological change that alters the structure of our society and the skills and knowledge demanded of the labor force.

Other goals on which there is considerable agreement between the two major political parties include: a stronger U. S. defense effort; hold the free world together, and strengthen its alliances both economically and militarily; build a powerful second-strike deterrent to safeguard the peace.

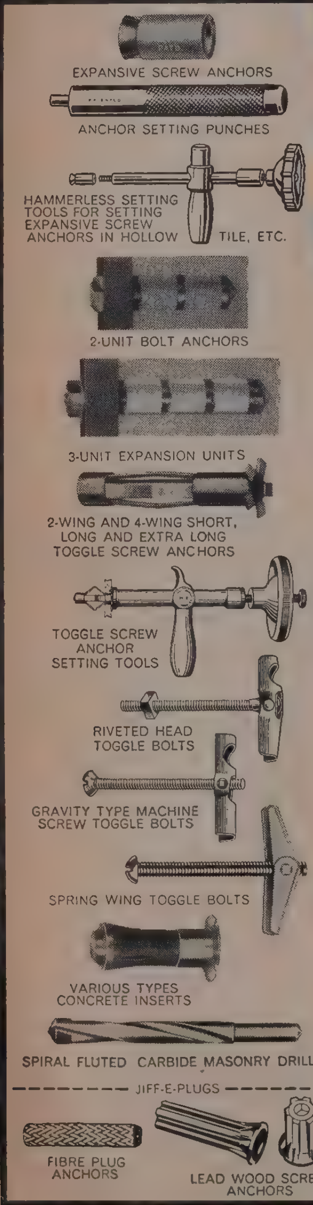
Just how each Presidential candidate and his party would achieve these goals, it is hoped, will be spelled out by them during the campaign, as well as other goals on which the candidates may differ.

New construction spending in July was less than in June despite a slight pickup in spending for new private residences, Dept. of Commerce reported. The July value of construction put in place was $5,182 million, or a seasonally-adjusted annual rate of $55.5 billion. This is down $72 million (annual rate) from the June rate, which drop occurred mainly in public construction projects, notably military facilities and highways.

Homebuilding in July, based on the number of housing starts, declined 10% from June. The seasonally-adjusted annual rate in July was 1,173,000 units, the lowest since last March's low rate for the year of 1,112,000 units due to severe winter weather, and 26% below the annual rate for July 1959. Census officials did not look for much improvement in August, since building permits have also been dropping for several months. For the first seven months of this year, housing starts are nearly 19% behind the similar period of 1959.

Electric power output hit a new peak in the week ending July 30, when production rose to 14.7 billion kwhr, 7% more than during the similar week in 1959. The previous record output was 14.5 billion kwhr for the week ending January 21, 1960.

Orders placed for electrical generating equipment during the first half of this year, measured in generating capacity in kw, increased over orders for the first half of 1959 by 70%, according to EEI.



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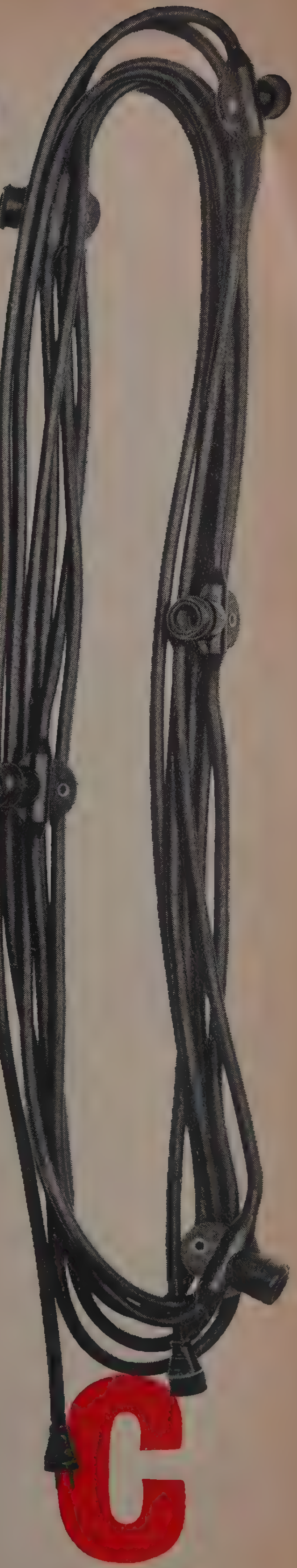

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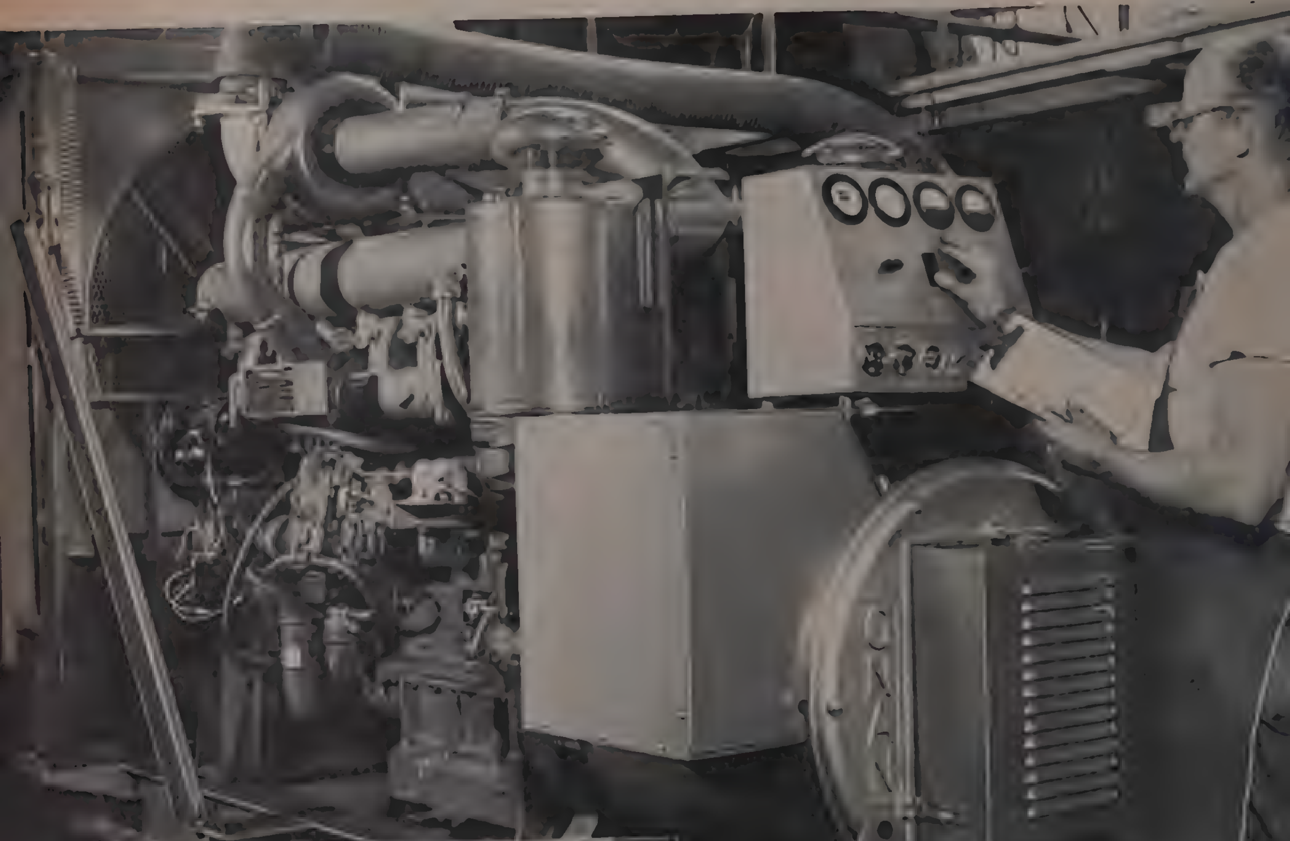

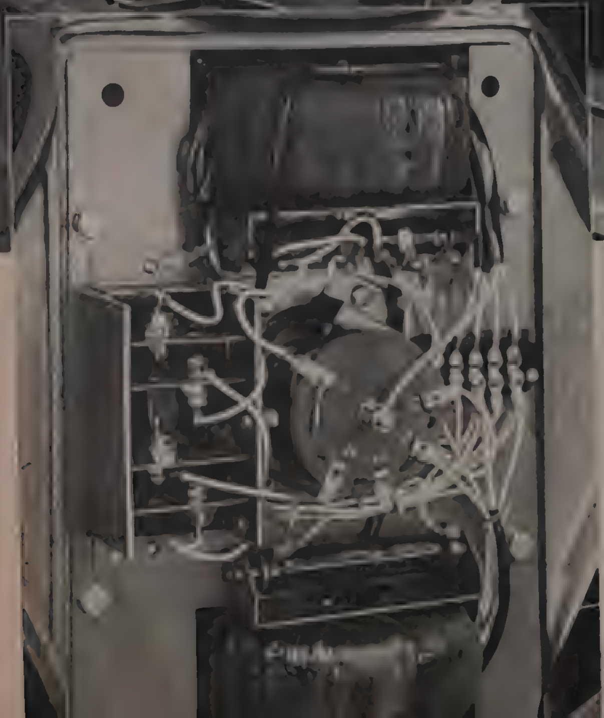

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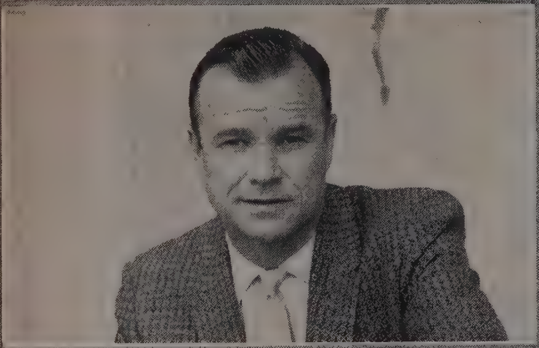

SAYS EUGENE V. GARDINER
OF GARDINER CONSTRUCTION CO.,
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"I wouldn't think of building a home without concealed telephone wiring and convenient extra outlets," says Eugene Gardiner, head of his own construction company 35 miles southeast of San Francisco. "It's a definite built-in sales feature.

"At one time, concealed telephone wiring was considered a luxury by home buyers," says Mr. Gardiner, "but not now. People *demand* it. When they buy a modern home they expect modern accessories and conveniences . . . and that includes phone equipment."

Mr. Gardiner builds homes in the $20,000-to-$30,000 range. Each of his homes is equipped with telephone outlets. "We've telephone-planned our homes since 1957," says Mr. Gardiner, "and we intend to continue doing so. It's a profitable investment."

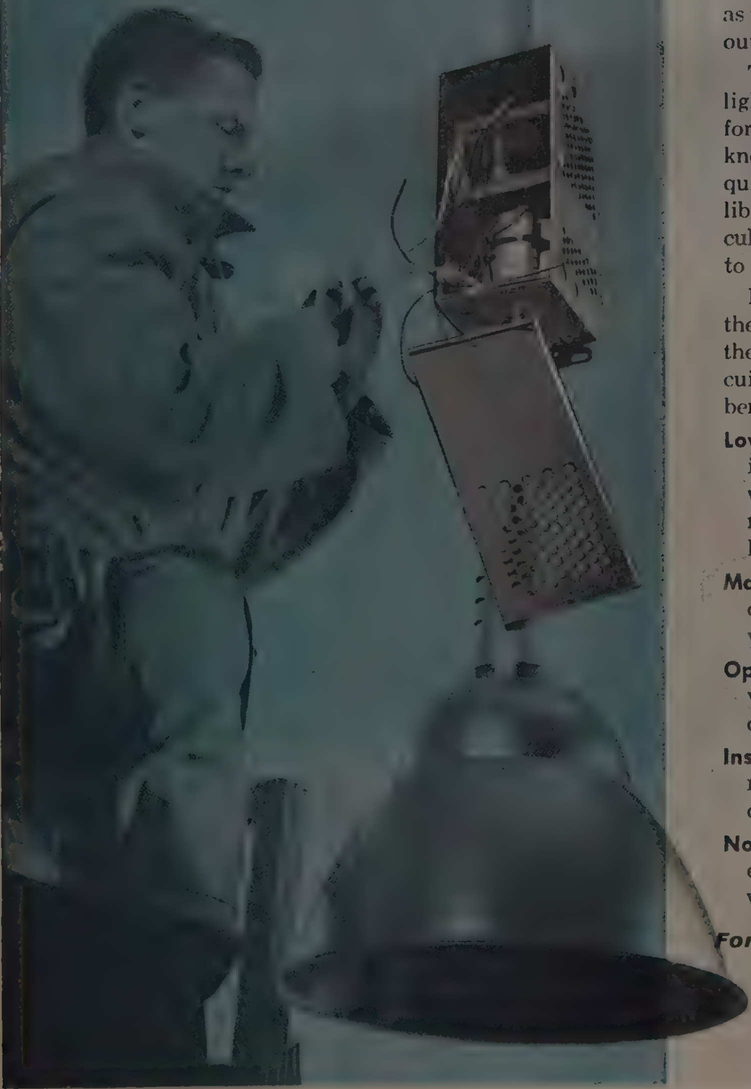
* * *

Your local Telephone Business Office will gladly help you telephone-plan your homes. For details on home telephone installations, see Sweet's Light Construction File, 11c/Be. For commercial installations, Sweet's Architectural File, 34a/Be.

BELL TELEPHONE SYSTEM

Telephone man Mason Layton checks concealed telephone wiring and position for outlet in a Gardiner "Mission Ranch" home at Fremont, Calif.

Sola indoor constant-wattage mercury-lamp transformers install easily, operate lamps down to 20° below zero



Now you can insure that your indoor mercury lighting installation will start and keep going even when temperatures slip far below zero. No longer is it necessary to use special, premium-priced indoor transformers or the still more costly weatherproof outdoor type for low temperature indoor installations. Sola's new standard line of indoor constant-wattage mercury lamp transformers keeps H-1, H-25, and H-33 lamps working down to minus 20°F. Two-lamp and single lamp units are both available for these input voltages: 115, 208, 230, 277, 460, and 575. They are ideal for shed, dock and warehouse installations as well as indoor remote mounting to serve outdoor mercury circuits.

These indoor transformers have new, lighter-weight core and coil construction for easier handling. Long leads and twelve knockouts in the new-designed case permit quick and easy connection. The case is liberally perforated for plenty of air circulation around the core and capacitors to give cool, trouble-free operation.

Listed by Underwriters Laboratories, the new indoor transformers incorporate the well-known Sola constant-wattage circuit which gives you these performance benefits:

Low starting current—limits current during warm-up, eliminates need for heavy wiring and time-delay relays, and permits more lamps to operate on the lighting circuit.

Maintained light output — holds lumen output constant within ±1% for line voltage changes as great as ±13%.

Open and short circuit protection — prevents transformer and wiring from overheating.

Insures rated lamp life — reduces premature lamp failure by providing stable operating conditions.

No dropout when line voltage dips — eliminates lamp dropout even when voltage dips 30% from nominal.

For information, write for Bulletin MVI

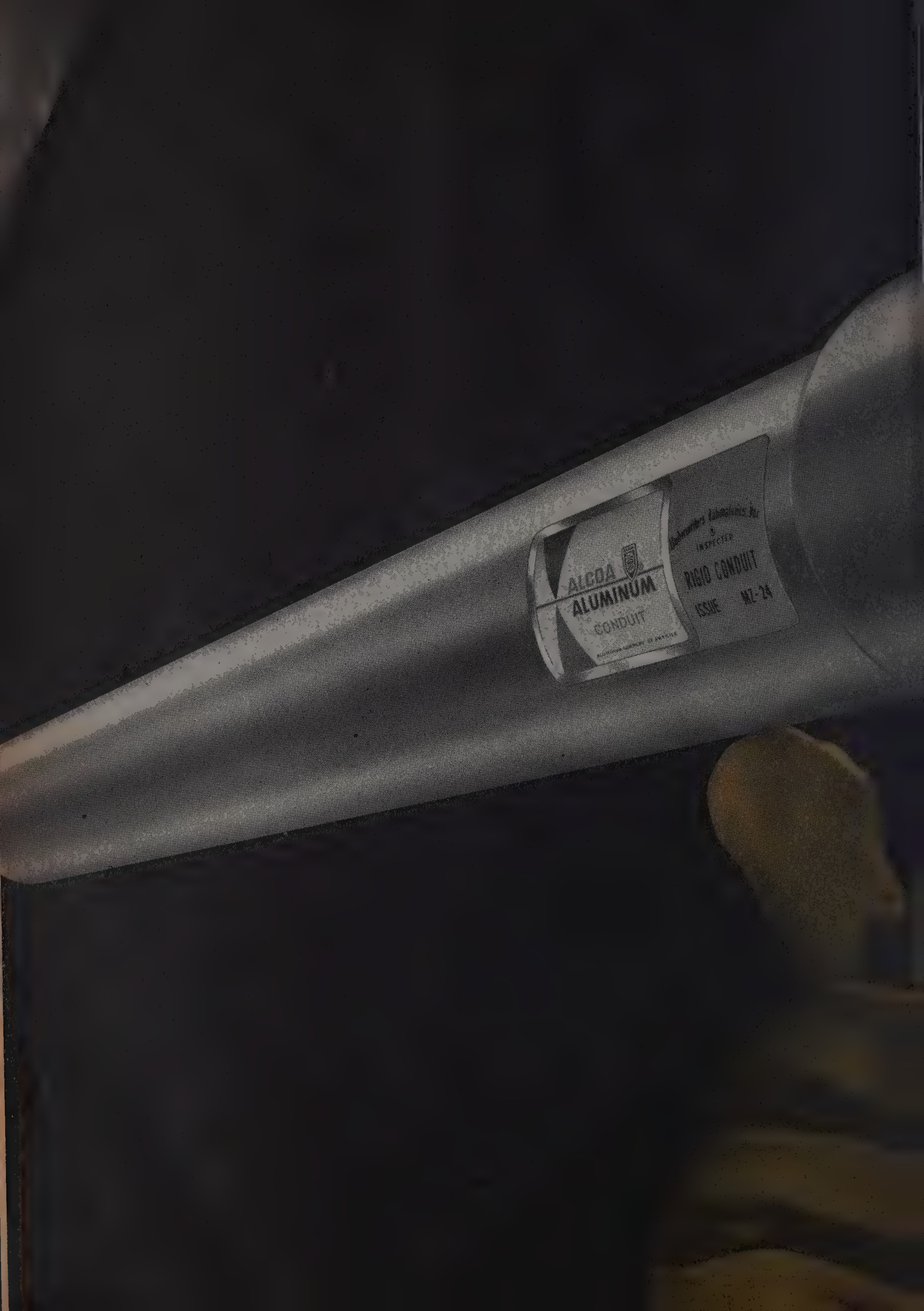
SOLA

A DIVISION OF
BASIC PRODUCTS CORPORATION

B P
C

SOLA ELECTRIC CO., Busse Road at Lunt, Elk Grove, Illinois

IN CANADA, Sola-Basic Products Ltd., 377 Evans Avenue, Toronto 18, Ontario


ALCOA
ALUMINUM
CONDUIT
ALUMINUM COMPANY OF AMERICA
Underwriters Laboratories Inc.
INSPECTED
RIGID CONDUIT
ISSUE MZ-24

Light weight!

One reason why Alcoa aluminum electrical rigid conduit costs less to install

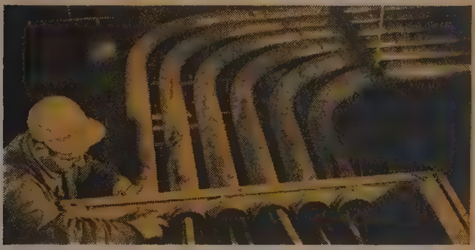
Heft a 10-foot length of 4-inch aluminum conduit. It weighs just 34 pounds. Compare this with 98 pounds for a similar section of steel conduit.

You benefit from this weight advantage in every phase of handling—lifting, loading, carrying, erecting. Result? Jobs go up faster.

You'll also find that aluminum conduit is easier to cut, bend and thread than conventional conduit. A hacksaw is adequate for cutting most sizes; bending usually is a one-shot task; and regular dies and cutting oils give you clean, sharp threads in a hurry.

Aluminum conduit is nonsparking, nonmagnetic, corrosion-resistant, and nontoxic. It looks good when you put it up and stays that way for years and years.

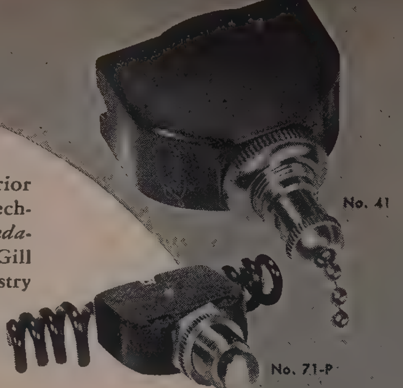
Get all the facts and figures in time for your next job. Contact your electrical distributor or one of our representatives. Or drop us a line for free literature. Write to Rome Cable Division of Alcoa, Dept. 7-90, Rome, New York.



OTHER REASONS WHY it costs less to install Alcoa conduit: you can cut it easily with a hacksaw, bend with an EMT bender, and thread quickly with a regular sharp die.

ROME CABLE
DIVISION OF **ALCOA**

For over fifty years, McGill's insistence on superior design and craftsmanship, scientific testing technique, and quality materials has meant *dependability* to users of electrical specialties. McGill continues to serve the changing needs of industry —with quality products such as these . . .

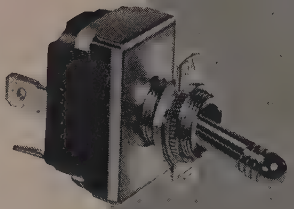


UNCONDITIONALLY GUARANTEED NO. 41 LEVOLIER® SWITCHES

McGill makes the only switch of its kind with an unconditional guarantee against failure in lighting circuits. The Levolier Switch is available for many lighting and power applications, in single-pole, single and two-circuit models with pull-chain, lever and push-button operations. From 3 to 20-amp. Underwriters Laboratories, Inc. inspected.

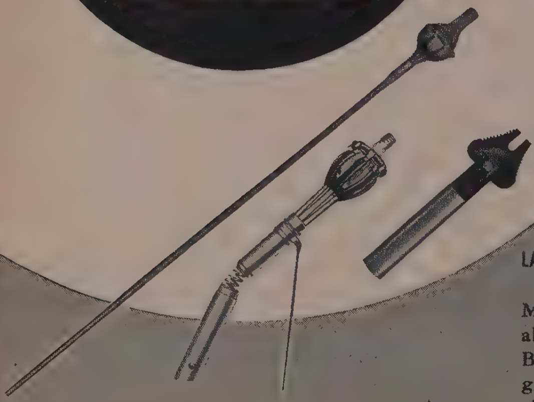
SPECIFY
McGILL®
BETTER-BUILT
LONGER-LASTING

QUALITY *Levolier®* SWITCHES



NEW DP MODEL LEVOLIER® TOGGLE SWITCHES

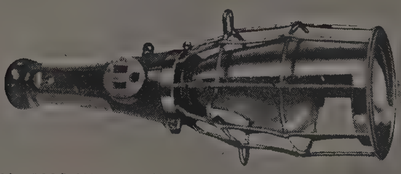
You can depend on McGill Toggle Switches for precision operation of motors, power tools, control panels, and countless other applications. Choose from a long line of SP and DP, two-circuit and three-way models. Choice of terminals, lever colors, circuitry arrangements. 6 to 20 amps. Underwriters Laboratories Inc. inspected.



LAMP CHANGERS — BROKEN LAMP BASE REMOVER

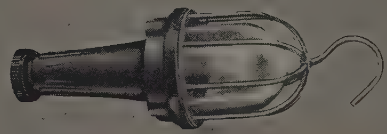
McGill lamp changers make lamp changing safe and easy. Available in a variety of heads for lamp bulbs of any size or shape. Broken lamp base remover avoids danger from shock or broken glass. Insulated poles, with or without angle adjustment, fit lamp changer or broken lamp base remover heads.

. . . AND PORTABLE LAMP GUARDS



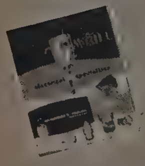
NO. 5000-SLRG. GROUNDED GUARD

- Non-conductive molded phenolic handle
- 3-wire convenience outlet
- 2 cage designs



3000 SERIES VAPORPROOF GUARDS

- Watertight, dust-tight, moisture-proof
- Fiber, steel, copper cages



Write for full information. McGill catalog 84 will provide you with full details and specifications for these and many other electrical specialties by McGill.

engineered electrical products

McGILL®

precision needle roller bearings

McGILL MANUFACTURING COMPANY, INC., ELECTRICAL DIV., 450 N. CAMPBELL ST., VALPARAISO, INDIANA

NO SERVICE PROBLEM HERE...

Exclusive with UNIVERSAL *"Service Guaranteed"* BALLASTS

For years, UNIVERSAL has been paying the bill for the replacement of in-warranty inoperative fluorescent ballasts. These payments are a direct part of the *exclusive* and *comprehensive* UNIVERSAL Two Year Warranty Service Program with ⓉⒺⓈ* Architects, engineers, contractors, distributors, fixture manufacturers and maintenance personnel are *all* relieved of the burden of service.

Should you be confronted with a lighting failure which appears to be abnormal, regardless of the number of ballasts involved, you are requested to telephone UNIVERSAL — COLLECT — and ask for ⓉⒺⓈ* *Within 24 hours* of your phone call, one of our field engineers will visit your installation. Assuming that our technical people determine that the lighting failure stems from ballasts which are being used in proper application, UNIVERSAL will arrange for the replacement of those ballasts and pay all charges in connection with the replacements, *including labor*. This is made possible by the high quality performance of UNIVERSAL "Service Guaranteed" BALLASTS in millions of fluorescent fixtures everywhere. *A fine product can afford a fine guarantee.*

You owe it to your own peace of mind to get the full details on this program. MAIL THIS COUPON FOR DESCRIPTIVE BROCHURE.

**Technical Engineering Service*

The only complete service program in the ballast industry!

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THE LARGEST INDEPENDENT MANUFACTURER OF FLUORESCENT TRANSFORMERS IN THE UNITED STATES

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SUN 'N SAND Unique, different . . . appealing! Shades are an arresting blend of imported Italian sand-tone reed, handwoven with glistening brass accents. Satin white, diffusers. Sun 'N Sand — original . . . beautiful . . . modern!

V-5675 For hallways or tasteful accent lighting. Length 8¼", diameter 6½". One 100-W.

V-1677 Wide decorative and functional uses in living, dining, bedroom areas. 54" drop cord. Diameter 12". One 100-W.

V-1676 Designed for dramatic living room lighting. Three-light cluster. 48" white drop cords. Diameter 26½". Three 100-W.

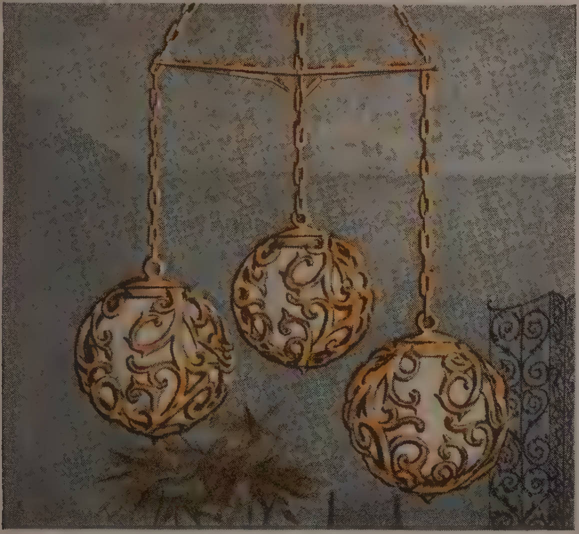
V-1675 Single unit 48" drop cord. Diameter 10½". One 100-W.

V-1673 Pulldown for living or dining rooms. Adjusts 20" to 56". Diameter 22". Three 60-W. 3 way switch.

V-1672 Same but 17" diameter. Two 60-W. On-off switch.

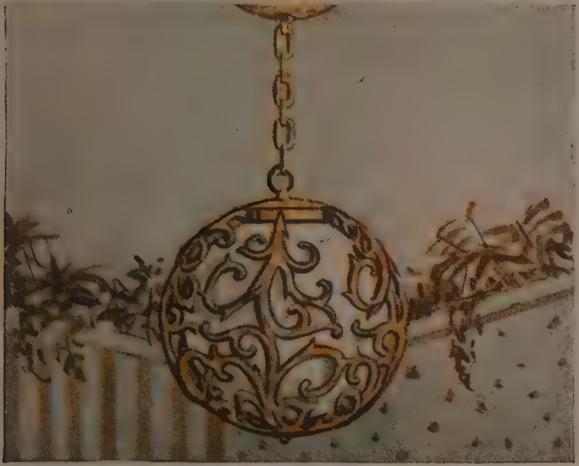
new custom creations

FLORENTINE SERIES Exquisitely detailed scrolls cast in aluminum. Antique white color delicately toned with gold fleck. White opal globes. Matching white chain. Here is new richness for all homes — contemporary, transitional, traditional!

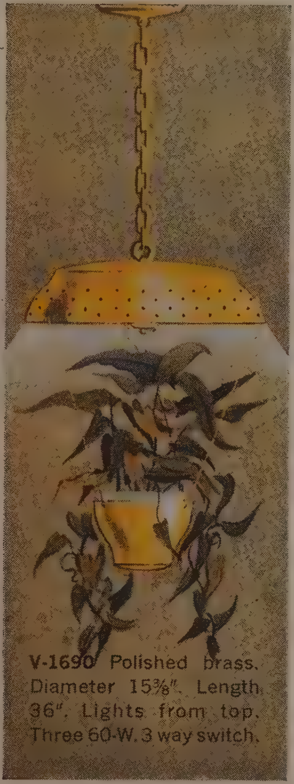


V-1713 Perfect in foyers, living rooms, dining areas. Spread 31″ (6′ chains and yolk). Three 100-W.

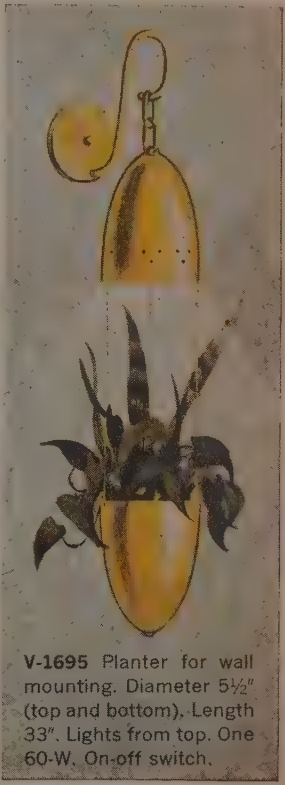
V-1712 Diameter 12″. Matching white 6′ drop chain. One 150-W.
V-1710 Same as above: Diameter 10″. One 100-W.



PLANTER SERIES Bright ideas! Lighting fixtures that double as planters. Perfect accents for fireplace, entranceways, in dinettes or family rooms . . . wherever you want a touch of eye-catching beauty!



V-1690 Polished brass. Diameter 15⅜″. Length 36″. Lights from top. Three 60-W. 3 way switch.



V-1695 Planter for wall mounting. Diameter 5½″ (top and bottom). Length 33″. Lights from top. One 60-W. On-off switch.

These are just a few of the fresh, new custom creations available...fixtures so delightfully different and irresistibly styled..."to show is to sell." Free colored brochure describing the full line available. See your nearest Virden Lighting distributor or write direct using the coupon below.

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MEMBER AMERICAN HOME LIGHTING INSTITUTE

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DIVISION OF JOHN C. VIRDEN COMPANY
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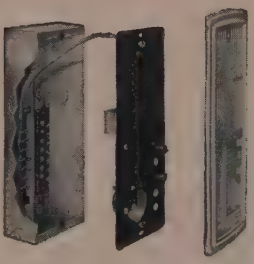
SUBSIDIARIES: LIGHTING DYNAMICS, INC., LOS ANGELES, CALIF. AND DALLAS, TEXAS; JOHN C. VIRDEN, LTD., TORONTO, ONTARIO.

NEW... most beautiful Apartment Telephones ever made!

- Equipped with cordless loudspeaker or watchcase receiver—your choice
- Modern, slim, streamlined design
- Aluminum face plate with beautiful anodized finish in brushed gold or silver
- Plug-and-receptacle installation
- Easiest telephone in the world to install and maintain
- Excellent voice reproduction
- Competitive price
- Pleasant-sounding audible signal
- Flush, semi-flush or surface wall mounting

Auth vestibule and lobby telephones also have been re-designed and are the last word in appearance and efficiency. Get complete facts today.

Apartment and vestibule telephones illustrated are cordless loudspeaking type. Also available are apartment telephones with watchcase receiver as indicated.



Exploded view of cordless loudspeaking telephone

Watchcase receiver type

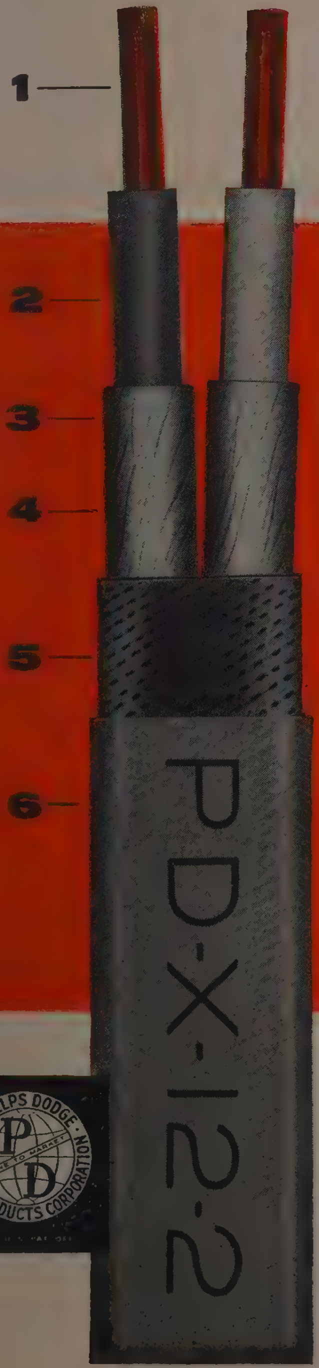
Auth
SINCE 1892

ELECTRICAL SIGNALING, TIME AND COMMUNICATION SYSTEMS FOR HOSPITALS, SCHOOLS, HOUSING, INDUSTRY AND SHIPS

Auth Electric Company, Inc.
LONG ISLAND CITY 1, NEW YORK

Contractors agree . . .

You can't beat Phelps Dodge Dependable PD-X Cable for fast, easy stripping!



Habirshaw type NM nonmetallic-sheathed cable saves vital on-the-job time and money!

Phelps Dodge Copper Products Corporation's PD-X cable is the fastest-stripping, cleanest-working nonmetallic-sheathed cable on the market today. Here's why:

1 Copper conductors are *soft* drawn. Connections are easily and quickly made.

2 Habirdure Thermoplastic Insulation is clean and smooth —makes stripping *simple, easy,* fast.

3 Paper armor is resin-treated to resist moisture, is clean and dry—no oil, grease or wax is used.

4 Paper armor is applied with a long twist and can be removed by an easy flick of the fingers. No time-wasting unwinding, no sticking to underlying insulation.

5 Barrier tape keeps finishing compounds out of the cable —leaves inside clean and free of gum. *Strips off cleanly as a unit with outer braid covering.*

6 Clean, grey finish eliminates sticking, *assures easy pulling,* clean walls and hands.

See Your Phelps Dodge Distributor!

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SALES OFFICES: Atlanta, Birmingham, Ala., Cambridge, Mass., Charlotte, Chicago, Cincinnati, Cleveland, Dallas, Dayton, Denver, Detroit, Fort Wayne, Greensboro, N. C., Houston, Indianapolis, Jacksonville, Kansas City, Mo., Los Angeles, Memphis, Milwaukee, Minneapolis, New Orleans, New York, Philadelphia, Pittsburgh, Portland, Ore., Richmond, Rochester, N. Y., San Francisco, St. Louis, Seattle, Tampa, Washington, D. C.

WAGNER UNIT SUBSTATION TRANSFORMERS

112½ to 2000 Kva—three phase, 60 cycles, 15 KV and below

VENTILATED DRY-TYPE—For indoor installation in reasonably dry, dust-free, well ventilated locations. Light in weight, ideal for multi-story buildings. No fireproof vaults required. Insulated for 80°C temperature rise.

for your plant's electrical system . . .

OIL-FILLED—Generally installed outdoors. Can be used indoors in fireproof vaults. Outdoor transformers can be connected to indoor switchgear using weather-proof bus-duct. 55°C rise, self-cooled or forced-air cooled.

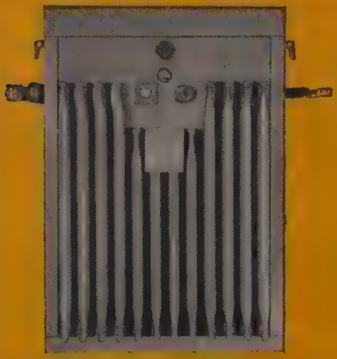
SELECT WAGNER

There's a complete line of Wagner Industrial Transformers. One or more of them will fit your specific needs whether you're planning a new plant distribution system, modernizing your present one, or adding to its capacity to meet increasing demands for power. So, select and specify Wagner Transformers. They'll give you long, dependable service because:

All Wagner Industrial Transformers are liberally designed, sturdily constructed, thoroughly tested, and able to meet the heaviest industrial demands. You get continuous, dependable power for years.

For your main plant substation, Wagner Liquid-Filled Industrial Power Transformers are available in standardized ratings through 10,000 Kva.

Load centers? Wagner makes PREDESIGNED Unit Sub-



NOFLAMOL—Non-inflammable liquid-filled. For indoor or outdoor installation, especially suited for chemical plants, refineries and similar locations where explosive liquids or gases are present. The close-coupled design fits flush against switchgear enclosures to save space. Throat connected designs are also available. 55°C rise, self-cooled or forced-air cooled.

SEALED DRY-TYPE—Hermetically sealed in welded steel cases to provide positive protection from contamination, fire and explosion hazards. Sealed tank is filled with inert nitrogen. Only maintenance needed is periodic checking of gas pressure. Can be safely installed in any load center.

WAGNER INDUSTRIAL POWER TRANSFORMERS

Oil-filled, for outdoor installations, available through 10,000 Kva, 67 KV and below.

Noflamol, non-inflammable liquid-filled for explosive atmospheres, available through 7,500 Kva, 15 KV and below.

The performance stability of Wagner Industrial Power Transformers is outstanding. Quality is designed and built into these transformers by specialists with years of transformer engineering and production experience. Highest quality materials . . . carefully controlled production methods . . . constant inspections and tests make sure these transformers give in-service performance that means better service for your system.

INDUSTRIAL TRANSFORMERS

station Transformers to meet your particular requirements. Furnished with suitable incoming line sections, these transformers will save you time and job engineering costs. And, you can specify the secondary switchgear you prefer.

Wagner Dry-Type Distribution Transformers are an economical choice for plant areas requiring 120/240 volts, single-phase or 208Y/120 volts three-phase.

Over 65 years of constant research and development has made Wagner a leader in transformer design . . . made the name Wagner one of the foremost in power planning. For expert advice on your present and future plant transformer needs, call or write the Wagner branch near you.

get economical, dependable, power packages!

Wagner Electric Corporation
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WAGNER DRY-TYPE DISTRIBUTION TRANSFORMERS

Single-phase 1 to 100 Kva—Three-phase 3 to 300 Kva—600 volts and below.

These dry-type distribution transformers have a low sound level, are compact and light in weight. They meet all safety requirements for indoor installation. They are economical to maintain . . . have no liquids, valves, gaskets or gauges.

Totally-enclosed non-ventilated dry-type transformers can be installed indoors or outdoors. Ventilated units as shown in right hand photo are for indoor installation only. Ratings through 10 Kva single-phase are filled with an epoxy compound . . . operate quiet as a whisper . . . perfect for areas where noise would be a nuisance. They, and three-phase units through 30 Kva are designed for wall mounting . . . other ratings for floor or platform mountings.

Available for high voltages of 120 x 240, 240 x 480, 480 and 600 volts to 120/240 volts single-phase, and 480 and 600 volts to 208Y/120 volts three-phase.

ELECTRIC MOTORS • TRANSFORMERS • INDUSTRIAL BRAKES • AUTOMOTIVE BRAKE SYSTEMS—AIR AND HYDRAULIC

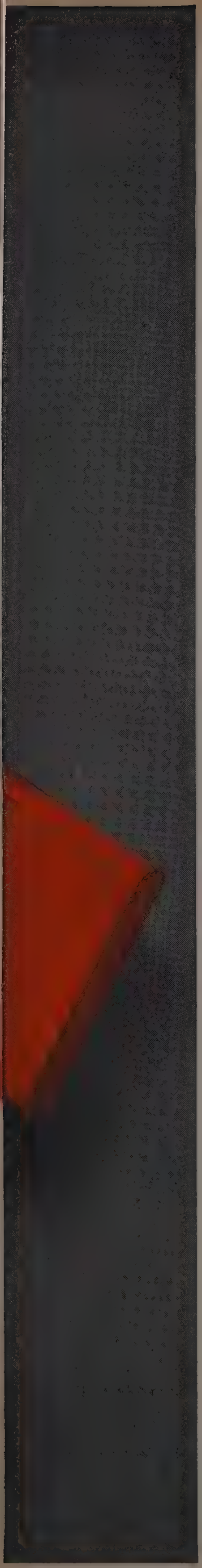
WT60-9

For fuses with 200,000 ampere interrupting capacity...

plus, **extreme current-limitation**

plus, **time-lag to prevent needless blows** – *you need . . .*

Buss LOW-PEAK fuses



A Revolutionary New Protective Device

Buss LOW-PEAK Fuses are designed to meet modern demands for electrical protection.

They safely interrupt fault currents up to 200,000 amperes . . . limit let-thru current to exceptionally low values . . . and hold 500% load for minimum of ten seconds.

Protect Mains, Feeders, Branch Circuits, Motors, Controllers, Switches—no matter whether the fault current is 1,000 amperes, 25,000, 100,000—or as high as 200,000 amperes.

Reduce stresses and prevent damage to Panelboards, Switches, Motor Controllers—other circuit components—because let-thru fault currents are limited to exceptionally low values.

Can be easily co-ordinated into a selective system—to limit fault outages to circuit of origin.

Prevent work stoppages, lights out, waste of time and money—because long time-lag keeps them from opening needlessly on motor starting currents or other harmless overloads.

Permit increasing interrupting capacity and current limitation on present electrical system at minimum cost. Buss LOW-PEAK Fuses fit standard switches and panelboards. Available from 15 to 600 amperes in both 250 and 600 volt ranges.

Guard motors against burnout from single phasing and overloads.

Low operating temperature reduces heating in switches and panels.

Provide thermal protection for equipment against damage due to poor contact.

Protect against waste of space and money by permitting the use of proper size switches and panels.

Remain safe throughout the years without maintenance or recalibration.

▼

Write for Buss
LOW-PEAK Bulletin
Now . . . or use coupon.

BUSSMANN MFG. DIVISION,
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Please send Buss LOW-PEAK Fuse Bulletin LPCS.

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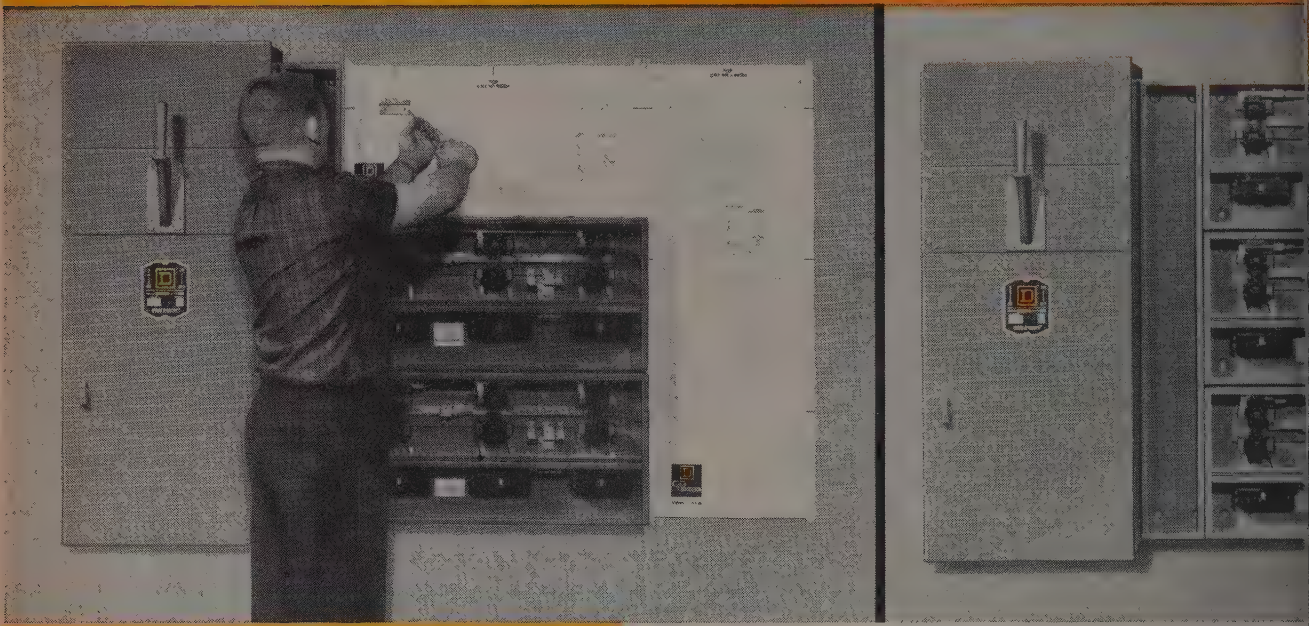
ECM-960

new Square D E-Z STACK



easy as hanging a picture...

and in stock at authorized distributors

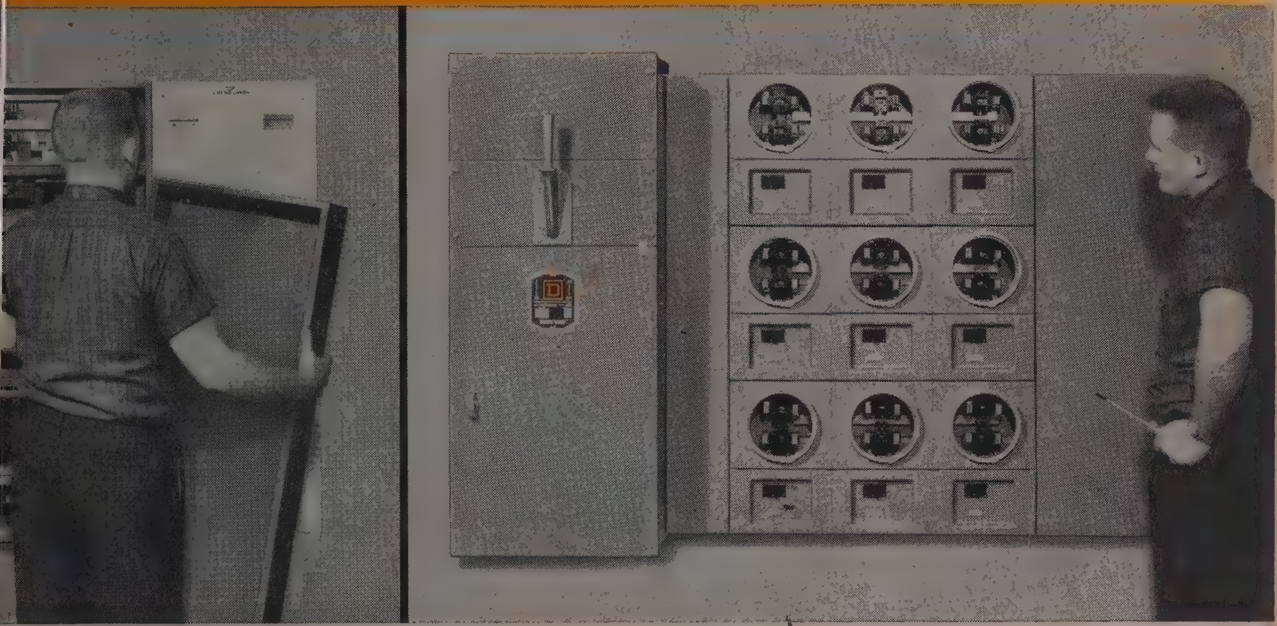
PLAN YOUR OWN ARRANGEMENT — Available wall space for the service and grouping of meters is frequently limited — and of a particular size and shape. Required locations of service and load conduits vary with each job. With E-Z STACK you have freedom of arrangement.

TEMPLATE LAYOUT — For installation convenience E-Z STACK devices include a full size template and wall mounting hanger brackets. Templates, attached to the wall, accurately position the hanger brackets for each device. Brackets on the wall interlock with clips on the back of the device.

AVAILABILITY — All E-Z STACK devices can be ordered by catalog number from authorized Square D Distributors *as they are needed.* Individually cartoned, the final decision as to the meter arrangement and size of the circuit breaker disconnect for

SQUARE D COMPANY

Apartment Metering Panels



each apartment can be determined at the Distributor's counter.

MAN-POWER — Unit assembly of the final configuration permits easier handling of all components. The wall brackets support each unit — in its proper place — while permanently securing and inter-connecting the entire installation.

WE CALL IT E-Z STACK BECAUSE — the basic meter-breaker devices easily stack one on top of the other. All devices are "meant for each other" — and bracket suspended. Knockouts in adjacent devices line up; bushings protect inter-connecting wiring. Load lug assemblies in disconnects and service entrance terminal boxes are pad-mounted in the right quantity for every E-Z STACK installation. All devices are designed for a specific purpose—multiple-metering installations.

Underwriters' Laboratories Approved

GET ALL THE FACTS! Send for new Service Equipment Bulletin No. SL-27 featuring E-Z STACK design multi-metering devices, a complete cataloging of features, specifications, suggested arrangements, and bills of material.

SQUARE D COMPANY • c/o Department SA-151
Mercer Road, Lexington, Kentucky

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COMPANY______________________________________

ADDRESS______________________________________

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wherever electricity is distributed and controlled

ANNOUNCING . . . the

LIGHTEST

and most powerful 4″ segment bender on the market

See this bender
demonstrated at the
NECA SHOW,
October 24-26, 1960—
BOOTH 155-157

Greenlee No. 777

(1-1/4″ thru 4″)

weighs only 65 lbs.

(exclusive of shoes)

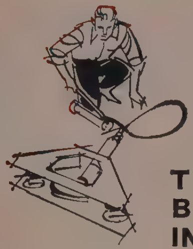
COMPARE THESE IMPORTANT ADVANTAGES . . .

FEWER PARTS

one-piece frame of high-strength aluminum

one set of aluminum pipe supports for all pipe sizes

one set of safe, quick-locking pipe support pins.



THREE BENDERS IN ONE

a few optional parts adapt the No. 777 segment bender to fast, one-shot 90° bending 1/2″ thru 2″ and thin-wall bending 3/4″ thru 2″.

SAFE, ONE-MAN OPERATION

safety valve in pump, oil by-pass in ram, weighs only 65 lbs. excluding bending shoes.

Unmatched for over-all performance, the new Greenlee No. 777 does more jobs for you than any other bender of its type. Use it to make offsets . . . large sweeps . . . concentric bends . . . one-shot 90° bends . . . thin-wall bends.

Its 27-ton ram has power to spare for segment bending of steel or aluminum conduit and pipe 1-1/4″ thru 4″ — will bend extra heavy schedule 80 pipe. Comes equipped with a hand hydraulic pump, but can be operated with power pump for even faster performance.

OPTIONAL EQUIPMENT FOR ONE-SHOT AND THIN-WALL BENDING

One shot 90° bending 1/2″ thru 2″

90° bends in one shot An important *exclusive* advantage you get with this new, light-weight GREENLEE segment bender. Simply by adding bending shoes and adapter, you can make any bend up to 90° in 1/2″ thru 2″ conduit or pipe in *one shot!*

Thin-wall bending 3/4″ thru 2″

Quickly mounted thin-wall attachment The No. 777 segment bender can be quickly and economically converted to bend thin-wall conduit 3/4″ thru 2″. Standard No. 770 thin-wall attachments fit the No. 777 bender with only the addition of one roller.

ASK YOUR DISTRIBUTOR FOR A DEMONSTRATION NOW! Write for bulletin E-249

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GREENLEE ®

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. . . cost control for contractors

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DODGE REPORTS are individual building project reports. They're mailed to you daily. You get REPORTS on just the types of building you're interested in—in the area where you do business. They tell who's going to build what and where . . . whom to see . . . when bids are wanted . . . who else is bidding . . . who gets which awards.

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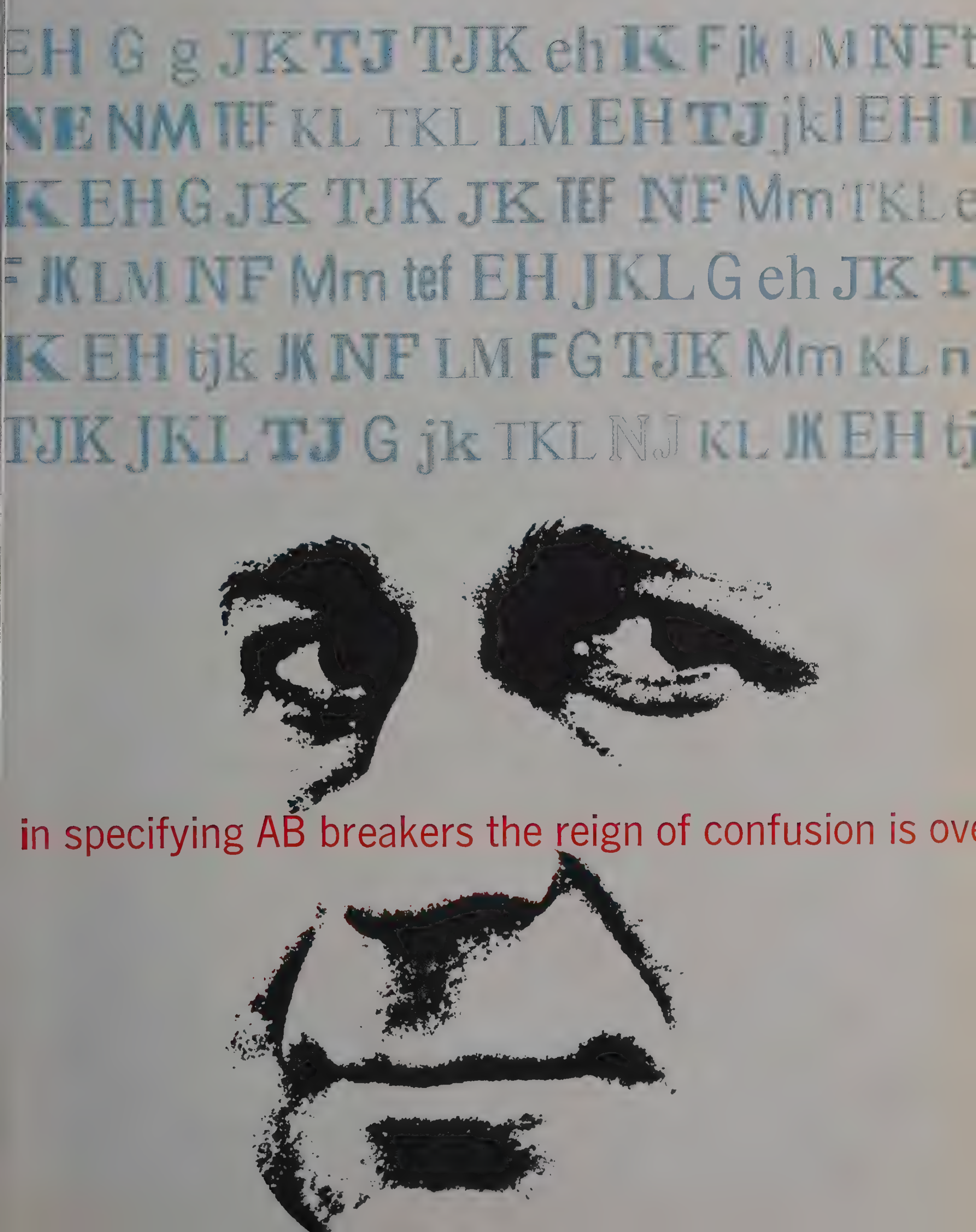
City__________Zone__________State__________

F. W. DODGE
CORPORATION

Dodge Reports

HELP
ELECTRICAL CONTRACTORS
GET MORE BUSINESS


EH G g JK TJ TJK eh K F jk L M NF t
NE NM TEF KL TKL LM EH TJ jkl EH
K EH G JK TJK JK TEF NF Mm TKL e
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K EH tjk JK NF LM F G TJK Mm KL n
TJK JKL TJ G jk TKL NJ KL JK EH tj
in specifying AB breakers the reign of confusion is ove

Westinghouse completely redesigns its breaker line

SIMPLE TO SPECIFY/EASY TO IDENTIFY

Newly designed breaker line simplifies frame designations . . . reduces space requirement up to 50%. Because of recent Westinghouse engineering advances, these new breakers retain the same high interrupting capacities of older designs in smaller frame sizes. The new designs mean it's easier for you to order, install and use AB breakers. Gone is the confusing assortment of letters that designate other models. These new breakers are easy to identify because they follow a common-sense sequence. They're simple to specify because you choose from only six breakers for virtually every application. They're better to use because they're smaller . . . yet you have the same quality and reliability of the former Westinghouse models you've been using.

EXECUTONE EXTRAS

help you bid profitably on intercom and sound systems

In today's big market for sound and intercom, Executone equipment is known for *highest standards of performance*. Hundreds of contractors are *also* discovering that they can put in a reputation-building Executone system at *lowest installed cost*. Here's why:

- **MINIMUM FIELD ASSEMBLY** Executone equipment is engineered for minimum assembly time on the job to meet contractors' field-installation problems. Most equipment comes completely assembled . . . components have plug-in terminal blocks. Hook-up time is cut to a bare minimum.
- **COMPLETE CO-ORDINATED SYSTEMS** You get everything you need from one responsible source . . . proven equipment, wire specifically designed and color-coded for the system. One-source responsibility cuts paper-work, delays, confusion.

EXPERT PRE-PLANNING Without obligation, your local Executone distributor will provide you with the services of an experienced systems engineer . . . to help in analyzing a project's needs . . . planning the required system with greatest installation economy . . . preparing bids and estimates.

- **INSTALLATION ASSISTANCE** An expert Executone field engineer is available to supervise every job. He helps you get in and out fast . . . assures you of proper hook-up, adjustment of the system and check out.
- **NO SERVICE CALL-BACKS** When you turn over the completed installation, Executone takes immediate responsibility for the proper operation of the system. The factory and the local Executone distributor give your customer unmatched guarantees and service on the premises.

Start building profits the Executone way. Check the coupon below for information on Executone sound and communication equipment for selected building types. We'll also send you a convenient Conduit Selection Chart to help you cut costs in layout and installation.

Executone

COMMUNICATION and SOUND SYSTEMS

Executone. Inc.
Dept. 5-9, 415 Lexington Avenue, New York 17, N. Y.

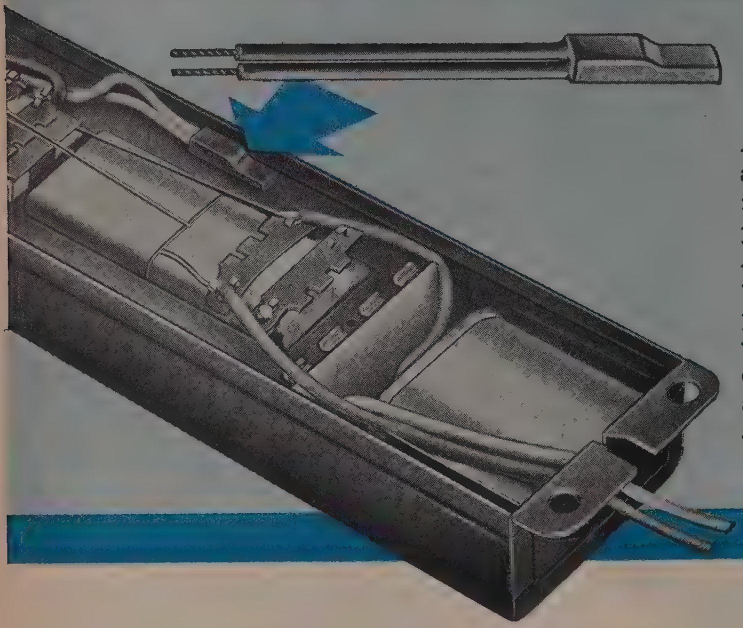
Send me your Conduit, Wire and Cable Chart. Also:
information on Executone equipment for
☐ schools ☐ hospitals ☐ offices ☐ plants
☐ retail stores ☐ homes ☐ ____________

Name________________________Title__________
Company____________________________________
Address____________________________________
City__________________Zone______State______

In Canada: 331 Bartlett Avenue, Toronto

PROTECT FLUORESCENT LIGHTING INSTALLATIONS

with ADVAN-guard® FLUORESCENT LAMP BALLASTS



ADVAN-guard,® a thermally actuated automatic reclosing protective device, introduced by ADVANCE almost 3 years ago, is an integral part of every ADVAN-guard® Ballast. It is sensitive to voltage and current as well as temperature and protects against excessive voltage supply . . . internal ballast short circuiting . . . inadequate lamp maintenance . . . improper fixture application and eliminates the need for individual fixture fusing.

ADVAN-guard® is sealed in the ballast housing and pre-set to instantly and automatically trip out whenever the ballast is operating at higher than recommended temperatures. When heat decreases to normal operating temperature, ADVAN-guard® resets automatically and the ballast resumes operation, adding years to ballast life by preventing ballast operation at abnormal temperatures. To assure maximum protection for fluorescent lighting installations, provide ADVAN-guard® Fluorescent Lamp Ballasts. ADVAN-guard® is listed by Underwriters' Laboratories, Inc. Write for detailed literature.

"The Heart of the Lighting Industry"®

ADVANCE® TRANSFORMER CO.

2950 NO. WESTERN AVE. CHICAGO 18, ILL. U.S.A.

Manufactured In Canada by: ADVANCE TRANSFORMER CO. Ltd., 5780 Pare St., Montreal, Quebec, Canada

Steel

This mark tells you a product is made of modern, dependable Steel.

Rigid steel conduit permanently protects circuit conductors against physical damage

So certain is this protection that the National Electrical Code includes the use of rigid steel conduit for all applications and locations—both inside and out. And, it *specifically* requires rigid steel conduit in particularly hazardous locations with explosive atmospheres.

Why? Because rigid steel conduit possesses great strength; provides a grounded metallic system, and cannot be damaged by moving objects. What's more, in case of a mishap due to faulty wiring, lightning, sudden shock or overloading, rigid steel conduit contains the damage and keeps it from spreading.

Rigid steel conduit is easy to install, too! It bends, threads and cuts with a minimum of effort. It is also compatible with all building materials, adaptable to all construction, fits anywhere and expands easily.

America's leading steel pipe manufacturer supplying America's foremost conduit manufacturers.

USS

TRADEMARK

National Tube
Division of
United States Steel

Columbia-Geneva Steel Division, San Francisco, Pacific Coast Distributors
United States Steel Export Company, New York

FPE
FEDERAL PACIFIC
ON
OFF

triple safety at your fingertips!

Only the Federal Pacific type A-plus switch gives you triple protection: the complete safety of visible blades, plus the high current capacity of a circuit breaker, plus the high interrupting capacity of fuses. And at the touch of the big Rotary Handle, fingertip operation opens and closes the A-plus switch instantly—with a quick-make, quick-break mechanism that is fast . . . teaseproof . . . safe. What's more, the A-plus switch is rated for load break, not just disconnecting duty! Feature for feature, there is no switch that compares with the A-plus safety switch. Federal Pacific heavy duty industrial switches are available in ratings 30 through 1200 amperes, 250 and 600 volts, indoor and weatherproof enclosures. Write for Bulletin 1241, Dept. FP-5, Federal Pacific Electric Company, Newark 1, N. J.

FEDERAL PACIFIC ELECTRIC COMPANY

FPE

growth through creative energy

SYLVANIA INDUSTRIAL TUBES

take the loads reliably

Sylvania Industrial Electronic Tubes prove their ability in daily use to withstand widely varying load conditions. Vibration? Shock? They're built to take that, too, and still perform reliably.

Next time you need superior-quality replacement tubes see your *Sylvania Industrial Tube Distributor*. Better yet, see him soon and have your replacements on hand. He handles the full line of Sylvania Industrial Tubes for resistance welding, electronic control, induction heating and dielectric heating equipment.

Meet your SYLVANIA INDUSTRIAL TUBE DISTRIBUTOR. Ask him for the new "Sylvania Industrial Tubes" and "Gold Brand Reliable Tubes" booklets. Or write Electronic Tubes Division, Sylvania Electric Products Inc.,Dept. 159,1100 Main Street, Buffalo, N. Y.

POPULAR SYLVANIA GAS TUBES FOR CONTROL APPLICATIONS

Sylvania Type	Starting Voltage	Operating Voltage	Operating Current (ma) Min.	Operating Current (ma) Max.
VOLTAGE-REGULATOR TYPES				
0A2	155	150	5	30
0B2	115	105	5	40
0B3	125	90	5	30
0C3	135	105	5	40
0D3	180	150	5	40
5644	130	95	5	25
VOLTAGE-REFERENCE TYPES				
5651	115	87	1.5	3.5
6308	115	87	1.5	3.5

SYLVANIA

Subsidiary of **GENERAL TELEPHONE & ELECTRONICS**

Naugatuck KRALASTIC®

Here's why large East Coast utility chooses KRALASTIC conduit

Ease of use Unlike the wood moldings and rigid type of conduit normally used, KRALASTIC conduit can be flexed to follow irregularities of pole or mounted equipment, saving many needless breaks or fittings. It is simply and quickly cut to length with a hacksaw, securely stapled in place. And conduit of KRALASTIC is easy to handle because it's lighter than aluminum.

Protection KRALASTIC is an excellent electrical insulator. It is extremely tough, even in thin-wall sections, in this case allowing reduction in conduit diameter from the previously used 2" to 1". It not only requires less material, but is less bulky and easier for linemen to climb around. KRALASTIC's unusual toughness protects against accidental damage from linemen as well as storms and other causes. And, of course, KRALASTIC can't rust, rot, or corrode, withstands weather at its worst.

Economy Because extruded KRALASTIC conduit is relatively inexpensive, unusually easy to work with, and extremely durable, it provides important savings in all areas.

What's *your* line? If it involves piping or conduit, it might well call for KRALASTIC...the original ABS plastic that has proved its superiorities in nearly 10,000 miles of piping installations, in other products from baby combs to football helmets. Better look into KRALASTIC *now*.

United States Rubber
Naugatuck Chemical Division
934K ELM STREET
NAUGATUCK, CONNECTICUT

KRALASTIC RUBBER-RESINS • **MARVINOL** VINYLS • **VIBRIN** POLYESTERS

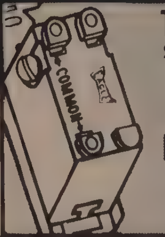
Akron · Boston · Chicago · Gastonia · Los Angeles · Memphis · New York · Phila. · CANADA: Naugatuck Chemicals · Elmira, Ont. · Cable: Rubexport, N.Y.

NEW! DIFFERENT!

The ONLY SWITCH of Its Kind

TOUCH-A-MATIC

AN E-Z WIRE® DEVICE



THE ONLY
SWITCH WITH
BOTH
SCREW AND
E-Z WIRE
PRESSURE
TERMINALS

3 COMMON
TERMINALS
FOR
CONVENIENT
FEED
THRU
CONNECTIONS

COMPACT
USE IN ANY
POSITION

FEATHER TOUCH
INSTANT ACTION
ROCK IT—PUSH IT—TOUCH IT

PRESS IT
TAP IT
FLIP IT
ROLL IT

QUIET SWITCH

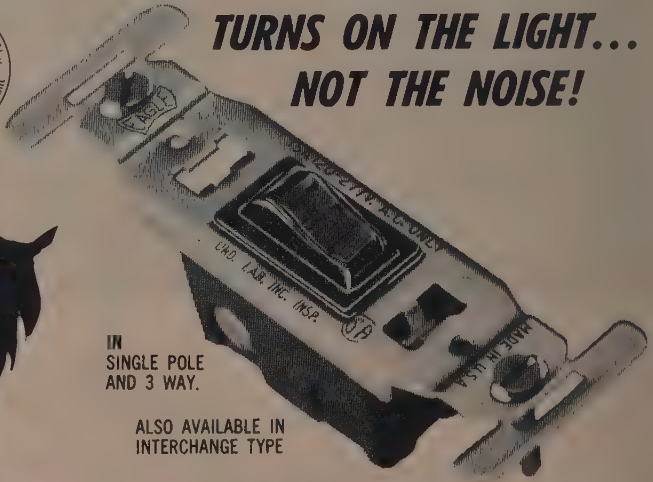
15 and 20 AMPS, 120-277 VOLTS AC ONLY

AUTOMATIC POSITIVE ACTION

Patent No. 2,743,330

Works Mechanically . . . Not Manually

MEETS
FED. SPECS.



*TURNS ON THE LIGHT...
NOT THE NOISE!*

IN
SINGLE POLE
AND 3 WAY.

ALSO AVAILABLE IN
INTERCHANGE TYPE

*THE SWITCH WITH **ALL** THE ADVANTAGES
AT NO EXTRA COST*

STOCK AND SPECIFY

TOUCH-A-MATIC

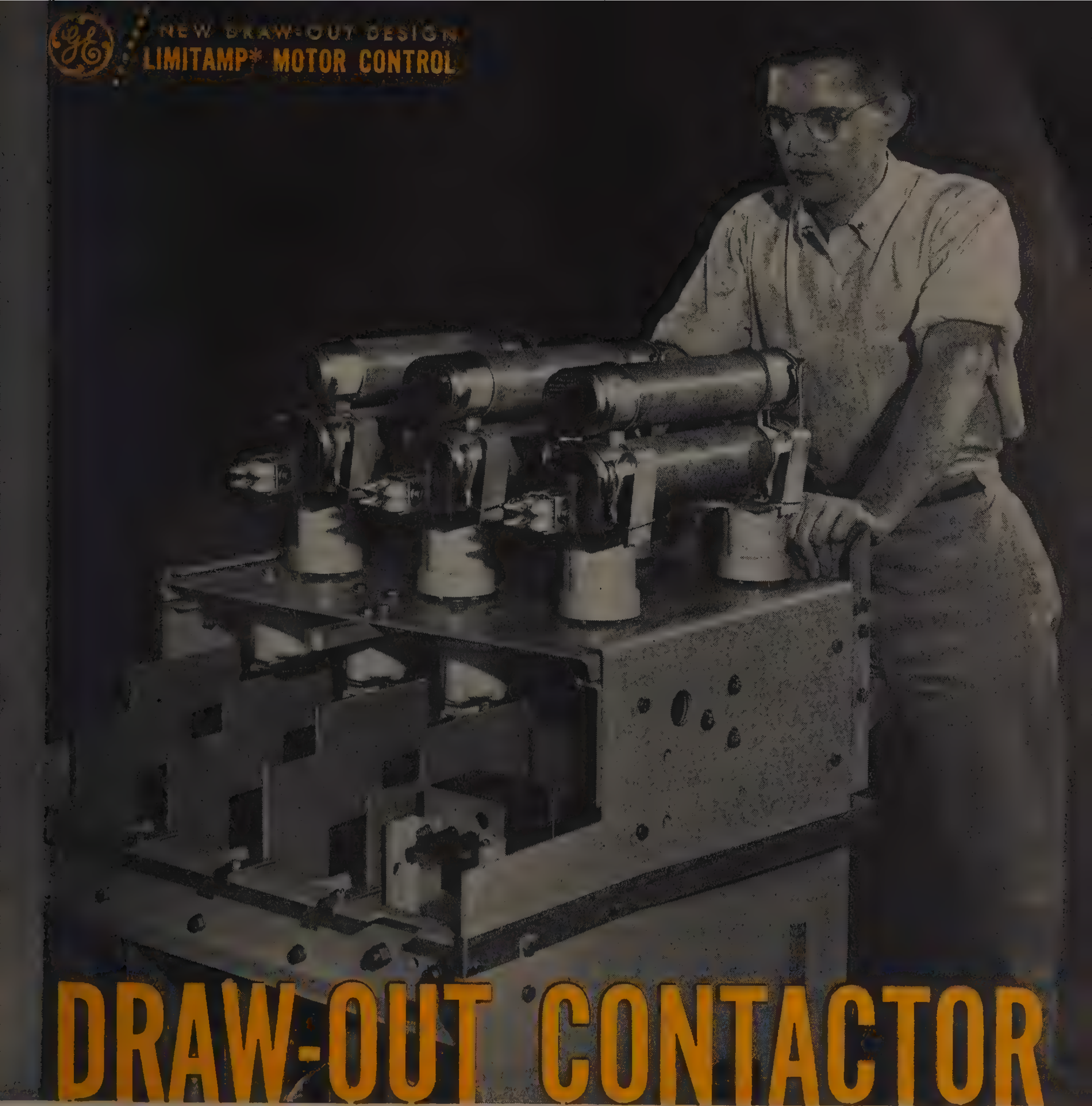
CASH IN ON THE DEMAND

*FOR **FREE SAMPLE** WRITE US ON YOUR LETTERHEAD*

See the TOUCH-A-MATIC at EAGLE booth No. 196 • Oct. 24-26 NECA Exposition — Las Vegas, Nevada

EAGLE ELECTRIC MFG. CO., INC.
LONG ISLAND CITY 1, NEW YORK
"PERFECTION IS NOT AN ACCIDENT"

NEW DRAW-OUT DESIGN
LIMITAMP* MOTOR CONTROL



DRAW-OUT CONTACTOR

. . . cuts Limitamp control installation time

Rated 2300- to 4600-volts for a-c motors up to 3000 hp.

A draw-out contactor which automatically connects or disconnects as it is rolled in or out of the enclosure!

This is just one of the revolutionary design features in General Electric's new Limitamp motor control . . . a new design which cuts installation time in half!

During installation the contactor is easily withdrawn, leaving ample room to enter the enclosure, pull both motor and incoming power cables and make connections. When cables are connected, barriers are placed in position to seal off incoming line cable and a-c bus. The motor cable—located in its own raceway—is completely accessible when the starter is de-energized.

As the contactor is rolled back in, stab-on contacts automatically plug into the de-energized power circuit. At the same time, control power is automatically engaged. Installation time is held to a minimum.

Ask your G-E Apparatus Sales Engineer about other advanced-design installation, operation, performance and maintenance features of new Limitamp control. Or, write Sect. 783-11, General Electric Co., Schenectady, N. Y. for Bulletin GEA-6893. Industry Control Dept., Salem, Va.

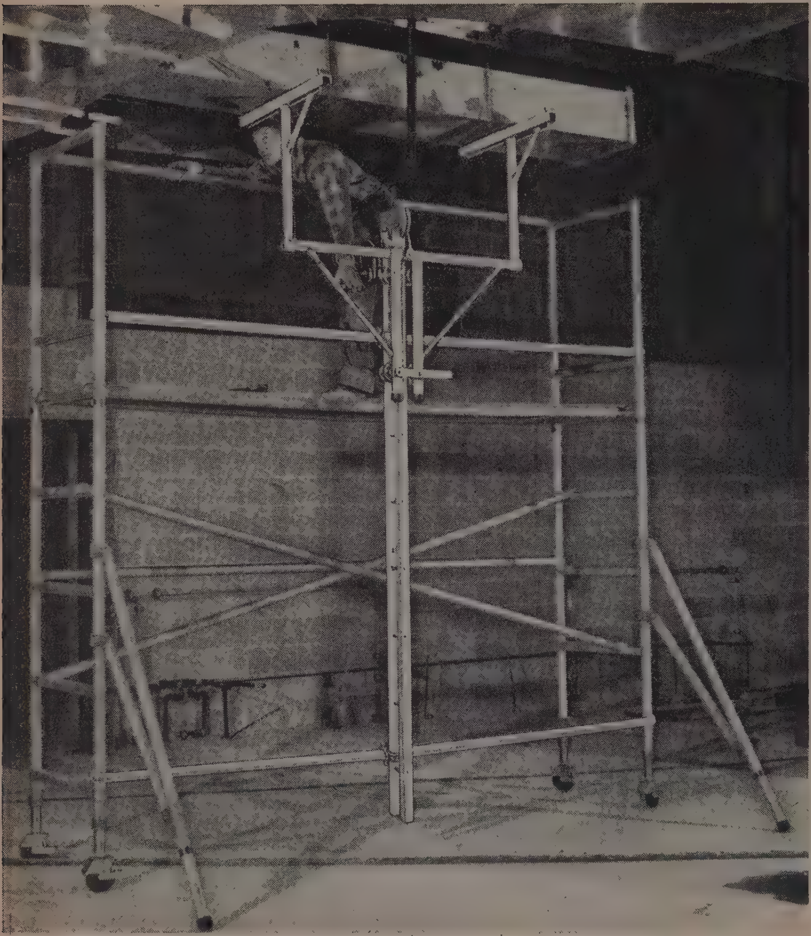
Progress Is Our Most Important Product

GENERAL ELECTRIC

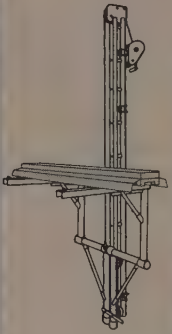
* Reg. Trade-mark of General Electric Company

Double your workman's production...

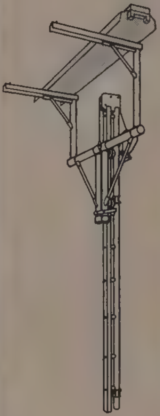
UP-RIGHT mechanical man lifts & positions material for fast, one-man installation



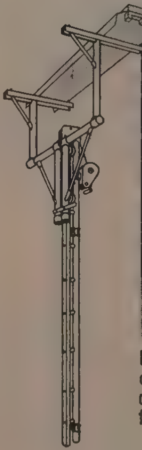
Workman and mechanical man accurately position 9 ft. long air duct for easy, rapid installation.



Fixture is placed on lifting arms at convenient chest height.



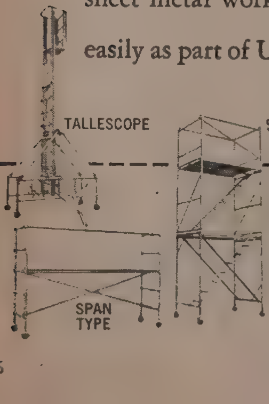
Fixture is elevated along vertical track by winch.



Lifting arms move horizontally on rollers and elevate fixture to desired position above workman for fast, convenient installation.

Mechanical man is an aluminum hoist assembly instantly attachable to any Up-Right or other scaffold. It saves fatigue and manhours in positioning fluorescent fixtures, bus-ducts, conduit, pipe and sheet metal work for overhead installation at any height. Rolled easily as part of Up-Right aluminum scaffold.

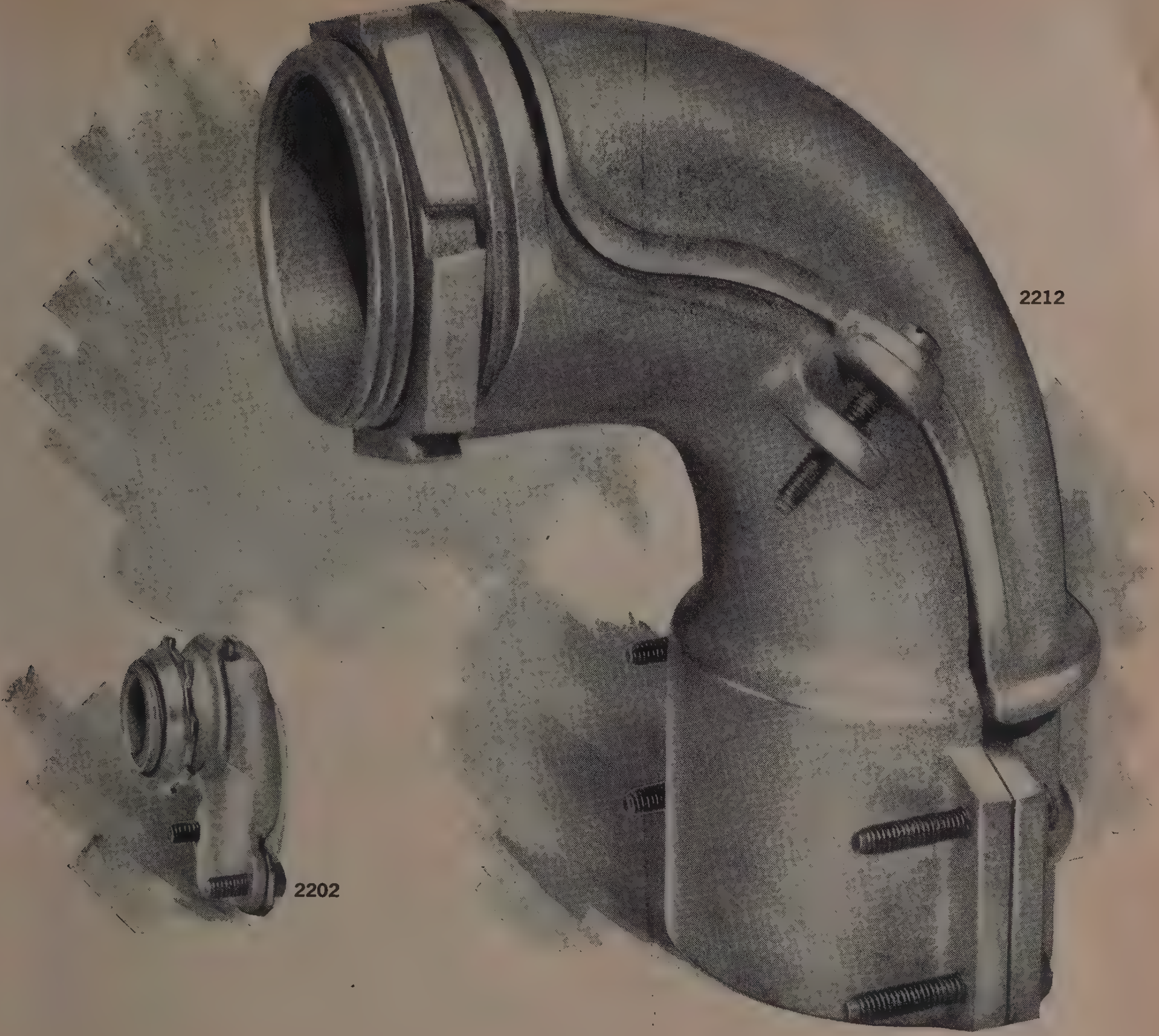
Write for descriptive circular



UP-RIGHT SCAFFOLDS

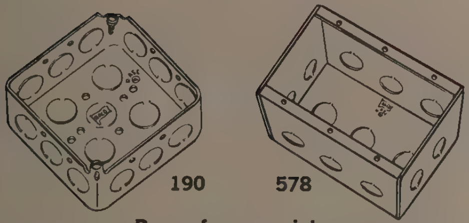
DEPT. 177 1013 PARDEE, BERKELEY, CALIFORNIA

In Canada: Up-Right Scaffolds Ltd., 120 Russet Ave., Oshawa, Ontario



Fittings for every need

from one reliable source... RACO



Boxes for every job

Raco boxes offer you more dollar-saving installation benefits than any other. It's the longest line, too.

No matter what you need fittings for, you can avoid problems by specifying Raco. You'll find threads are deep and true. Set screws are in place and turn easily. Finishes are bright and clean.

From the largest service entrance fitting to the smallest, you'll find the right fitting at Raco.

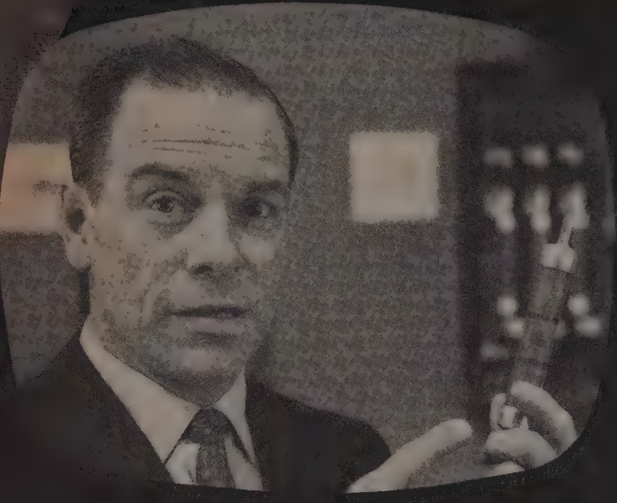
Most versatile and complete line of roughing-in materials.

RACO

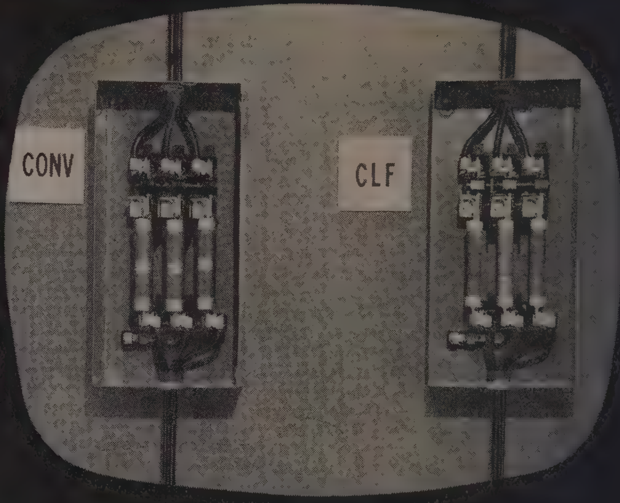
ALL-STEEL EQUIPMENT INC.

Aurora, Illinois

DON HERBERT reports on fuse test where . . .



Don Herbert, General Electric's TV Progress Reporter, brings you the latest news on fuse progress.



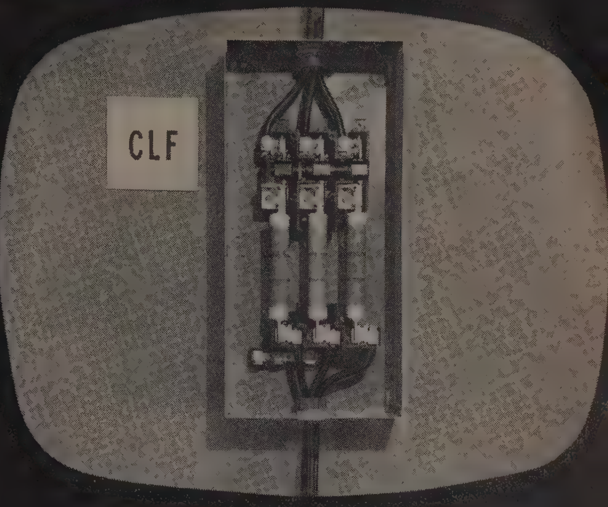
In a side by side comparison, conventional fuses and G-E CLF fuses are being tested at 40,000 amps short circuit.

You get top safety with

STOCKS OF CLF FUSES to meet your every need are available at your authorized General Electric distributor. The G-E CLF fuse is designed to meet the requirements of the NEMA and N.E.C. Standards, and Underwriters' Laboratories, Inc.

conventional fuses failed—G-E CLF FUSES DID NOT!

Close-up of Conventional Fuses shows that the 40,000 amp current surge has touched off a powerful explosion.



CLF fuses have safely opened the circuit, with no external disturbance.

General Electric CLF* fuses

You install fuses for protection—but do you know how much protection your presently-installed fuses are actually providing?

The tremendous expansion of power systems has greatly increased the short circuit levels in most industrial and commercial areas. Yours may be one area where this increase has exceeded the safe interrupting capacity of conventional cartridge fuses. That's where General Electric's CLF Fuses, with high interrupting capacity of 200,000 amps, give you *sure* fuse protection.

The CLF fuse is available in ratings 6 through 4000 amps, up to 600 volts. It can truly be called the "fuse of the future" because:

- 200,000 ampere interrupting rating virtually eliminates the possibility of its being applied beyond its ratings
- pure silver elements and high-strength casing are not susceptible to aging
- pure silver elements will not weaken on current surges which do not melt the fuse
- current limiting action reduces or eliminates system damage caused by short circuit stresses during interruption time
- silver plated terminals won't deteriorate with age—maintain efficient, low-resistance contact surface.

534-06

Your General Electric Distributor is equipped to answer your questions on CLF protection and in most cases can serve you from stock. Standardize on G-E CLF fuses and forget your short circuit worries.

*Trademark of General Electric Company for high interrupting capacity fuse which meets New NEMA Standard FU 1-1959.

Progress Is Our Most Important Product

GENERAL ELECTRIC

"Equal to RLM" ...Anyone can Say it!

BUT

Only the RLM LABEL can GUARANTEE IT with a continuous RLM Test Program of Inspections by the ELECTRICAL TESTING LABORATORIES

"Equal to RLM" is a claim that is often made by sellers of industrial lighting equipment. No finer compliment could be made to the high quality RLM specifications!

However, RLM is more than a group of widely approved standards for industrial lighting equipment. RLM is also a guarantee of conformance. This guarantee is backed by the unbiased tests conducted by an independent testing laboratory—The ELECTRICAL TESTING LABORATORIES OF NEW YORK! These tests assure not only compliance with standards but every effort is made to insure that *every fixture* shipped to the buyer will be of uniform quality.

In the entire lighting industry there is no equal to this testing program...so in the truest sense there can be no such thing as "equal to RLM." RLM is unique...distinctive and above price to the buyer who wishes unbiased proof of quality.

THE FINAL INGREDIENT OF BEING SURE

Into each factory go ETL representatives to secure for test and certification purposes, samples of the manufacturer's RLM-labeled units.

PRODUCT QUALITY
LIGHTING QUALITY

These TWIN QQ's to Industrial Lighting Success are guaranteed with all lighting equipment bearing the RLM Label. Return of the coupon brings you full information.

RLM STANDARDS INSTITUTE, Suite 3199 326 W. Madison, Chicago 6, Ill.

Please send me free a copy of the new "TWIN QQ's" pamphlet, the latest RLM SPECIFICATIONS BOOK, and names of the leading manufacturers offering RLM-labeled lighting equipment. (Please write name, company and address in margin below.)

R-763

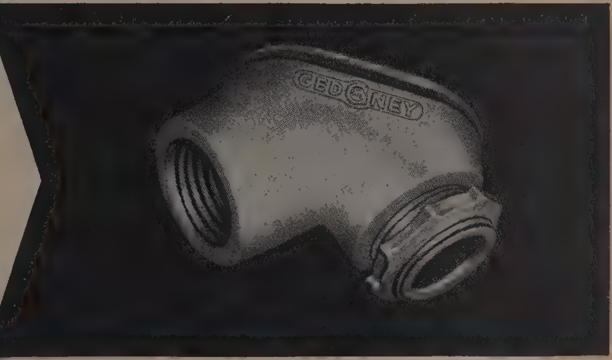
GEDNEY'S RIGHT THERE IN YOUR CORNER

helping save time . . . hold down costs

CORNER FITTINGS? Well, here are three that have proved immensely popular for the simple reason they're easiest to install – save time and labor that really counts up. Like the rest of the full Gedney line they're made of unbreakable malleable iron...accurately machined and threaded . . . individually inspected. Order Gedney – always – for lowest installed costs!

90° CORNER ELLS

Fitted with gasketed cover. Both ends female. Made of malleable iron, cadmium plated. Available in a full range of sizes from ½" to 2".



90° CORNER ADAPTERS

Fitted with gasketed cover. One end male, one end female. Made of malleable iron, cadmium plated. Your choice of sizes from ½" to 2".

CORNER PULL-IN CONDUIT ELLS

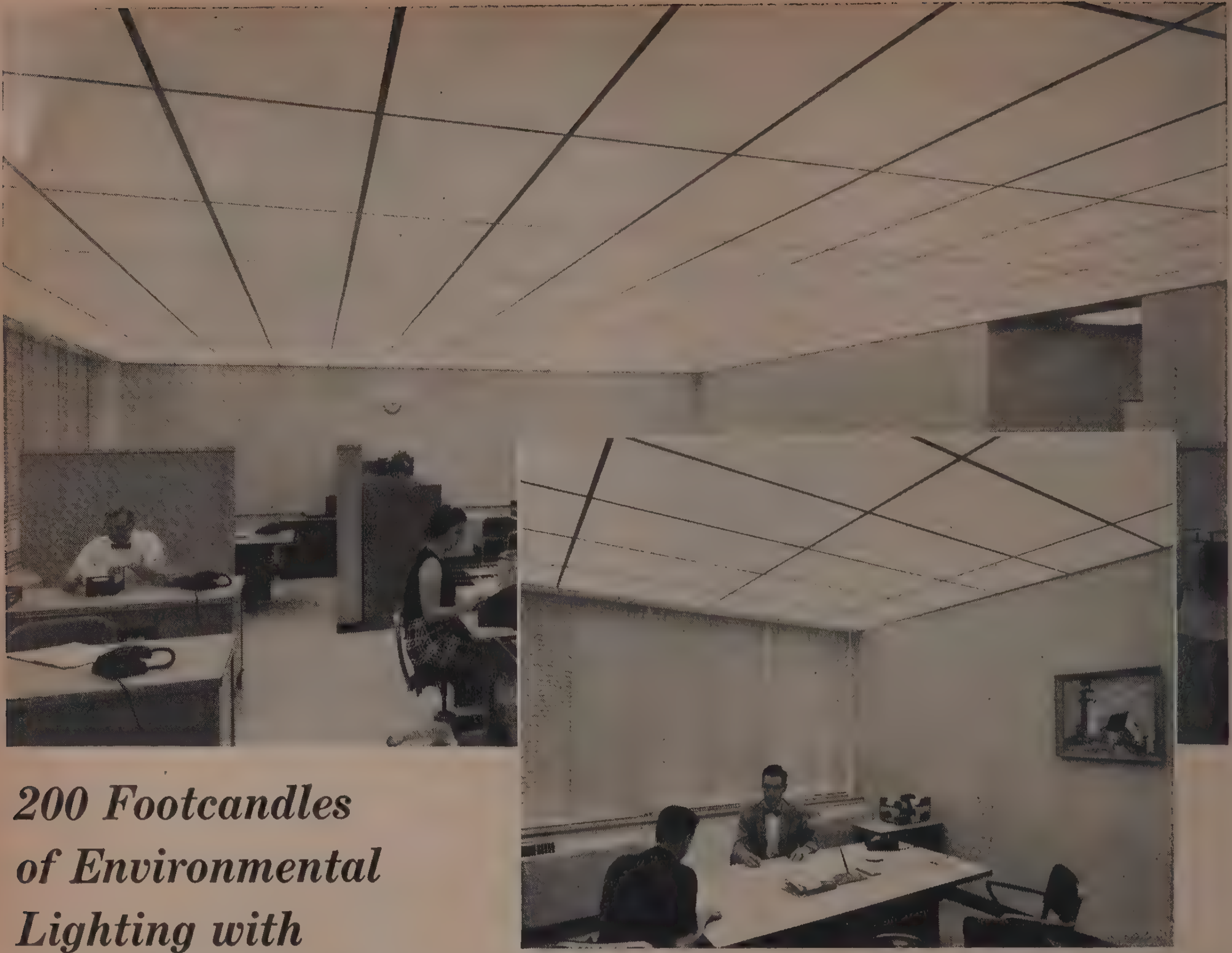
Today's top specification for space-saving, machine wiring, easy wire pulling. Malleable iron, cadmium plated. Sizes run from ½" to 2".

GEDNEY FITTINGS FIT

GEDNEY
ELECTRIC COMPANY

GEDNEY

RKO BLDG. • RADIO CITY • NEW YORK 20
Foundry, Factory and Shipping Point: Terryville, Conn.



200 Footcandles of Environmental Lighting with

SYLVANIA'S SYLVA-CELL SYSTEM

Sylvania's Sylva-Cell Lighting System often provides an installation with more than just superb lighting. Because of the versatility and attractiveness of this extended area lighting system, its use as a design element can contribute completeness and uniformity to the overall environment.

At West Penn Power Company's new Jefferson District Headquarters, Sylva-Cell gives soft, comfortable illumination to general areas, private offices and other individual rooms—with lighting levels of 200 foot candles or more.

At the same time it adds to the general effect by tying together and complementing the other design elements.

The flexible Sylva-Cell System—based on a 2′ x 4′ module—offers shieldings of plastic or aluminum louvers or Circlgrid, a new shielding with a refreshing, luminous circular pattern.

With its simplicity of installation and low-maintenance characteristics, Sylva-Cell can answer a wide variety of commercial and industrial lighting problems.

Look into the advantages of Sylva-Cell when your requirements call for high quality lighting plus a versatile design element to help create a comfortable, attractive atmosphere.

Complete details will gladly be sent on request.

SYLVANIA LIGHTING PRODUCTS
A Division of SYLVANIA ELECTRIC PRODUCTS INC.
One 48th Street, Wheeling, W. Va.

SYLVANIA

Subsidiary of ***GENERAL TELEPHONE & ELECTRONICS***

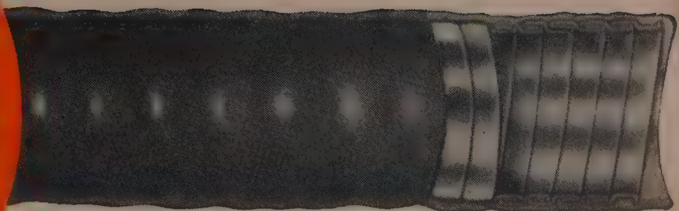
GENERAL ☎ SYSTEM

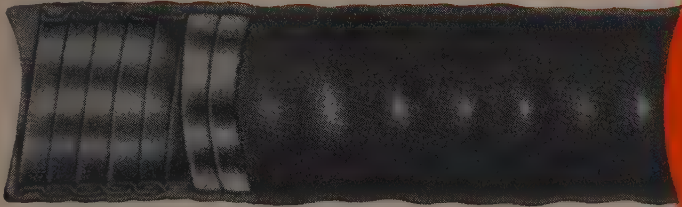
COLUMBIA

FLEX-SEAL

FLEXIBLE

liquid-tight electrical conduit





COSTS LESS*

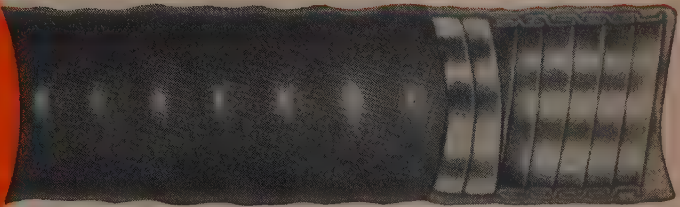
REDUCE MAINTENANCE

•

PERMANENT PROTECTION

AGAINST

WEATHER • CORROSIVE FUMES
OIL • GREASE • CHEMICALS
SALT SPRAY • DIRT
WATER



* It's a fact: your cost is lowest when your first cost is your last cost. You not only make a better installation—faster—it guarantees you a lifetime of dependable service . . . and then some.

NEC GUIDE—1960

Wallet-size guide, filled with helpful facts for daily on-the-job use. Write for your copy.

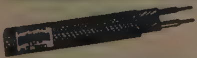
BROCHURE

Columbia Flex-Seal, type XL with bonding strip, is UL approved. Type EX, without bonding strip, is J.I.C. approved. Sizes from ⅜″ to 2″ ID. Write for informative brochure.

COLUMBIA CABLE & ELECTRIC CORP.

Serving the Electrical Wholesaler Since 1912

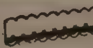
255 CHESTNUT STREET BROOKLYN 8, N. Y.



Non-Metallic Sheathed Cable

E. M. T.

Flexible Steel Conduit



Flex-Seal

A. C. T. Armored Cable

UF

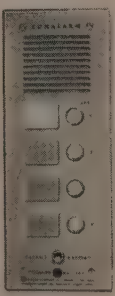
IF YOU'RE THE ONE CONTRACTOR IN TEN WHO'S SATISFIED WITH HIS PROFIT PICTURE... THEN READ NO FURTHER

We want to reach the go-getters... contractors who are alert to a good chance to pick up some more dollars. Here are some Edwards products that are naturals for the contractor that really wants to get out and do some creative selling. And we mean it when we say they're profitable. You have no fight with the manufacturer—you get these products through your electrical distributor and **you** do the installation...with the local Edwards man to help out in the more technical layout and specifications when you need him. You profit with the product **and** the installation. Learn how you can work these into your profit-making sales program.

1. Edwards Lamp Annunciator. Most up-to-date process variables and emergency indicator. A good prospect for power stations, refineries, chemical and processing plants, industrial operations. **2. Edwards In-Dicator.** Every business has need for this time-saving device, in fact any building where people work, using switchboards or receptionists. **3. Edwards Zonalarm.** Dependable, low cost fire detection and alarm systems; every building is a prospect. Cash in on this ideal installation for homes, stores, warehouses and plants.

1.

2.



3.

The prospects are there...the products are naturals...all it takes is a contractor with drive enough to sell. For complete information on these and other contractor profitables, call your local Edwards man today or write direct. While you're at it you might want to investigate the advantages for you in Edwards new Contractor Better Selling Program. Edwards Company, Incorporated, 90 Connecticut Avenue, Norwalk, Conn.

SPECIALISTS IN SIGNALING SINCE 1872

EDWARDS

CONTROL / COMMUNICATION / PROTECTION

(In Canada: Edwards of Canada, Ltd., Owen Sound, Ontario)

SURFACELINE

LIGHTING BY mille

New ... Shallow Fluorescent Fixtures with HINGED DOORS

Store, Office, Public Building ... New Building Project or Remodeling. Whatever the job ... consider these Surfaceline *benefits!*

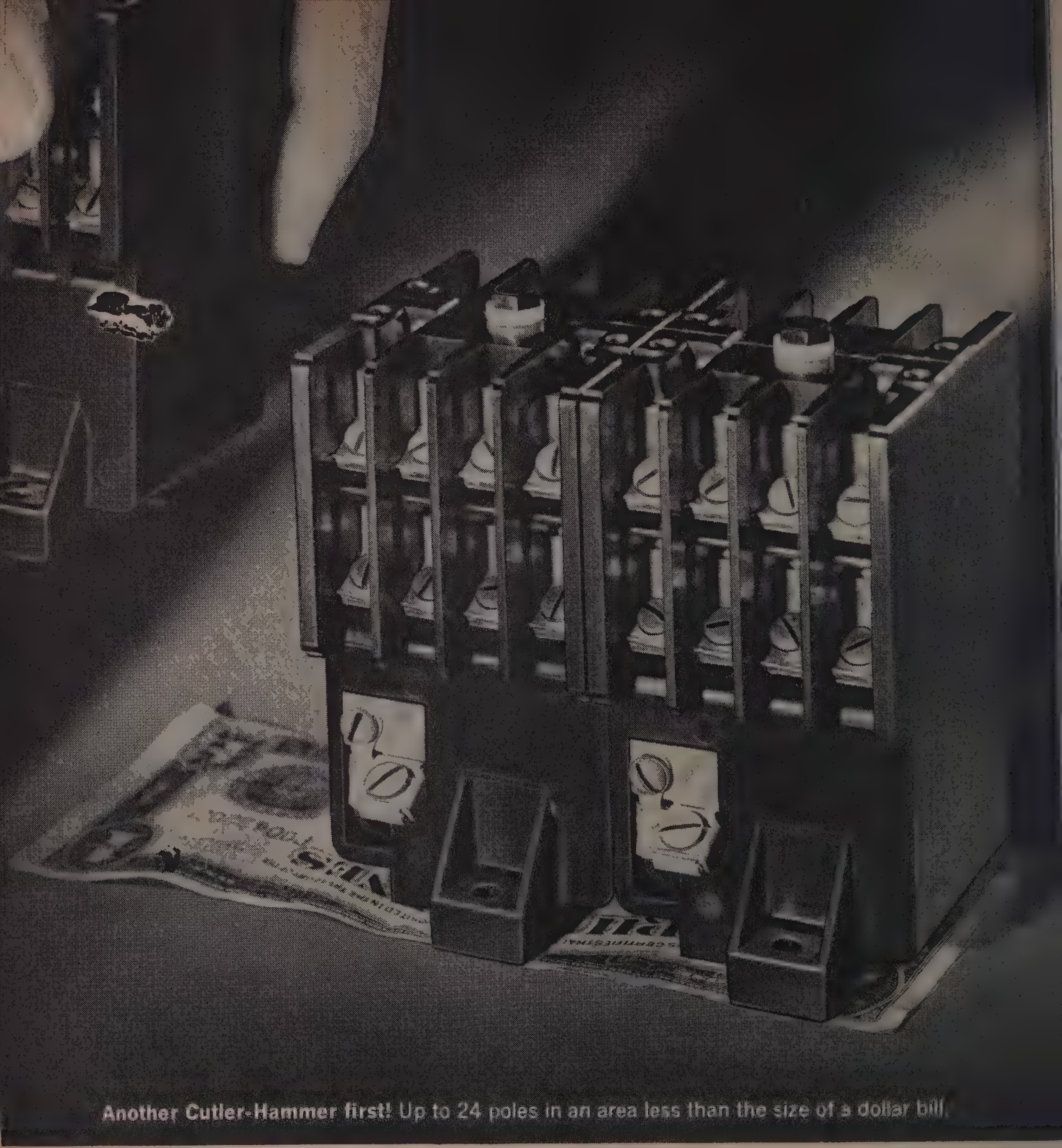
Appearance: Surfaceline's shallow depth and clean, modern lines assure you of pleasant, unobtrusive lighting.

Design Latitude: These fixtures can be economically installed singly, in modular patterns, or in continuous rows. Five sizes, five different plastic or glass closure bottoms.

Safe, Easy Maintenance: Miller's famous, "light-tight" hinged doors are secure, easily operated. Maintenance requires no tools ... no handling of loose parts.

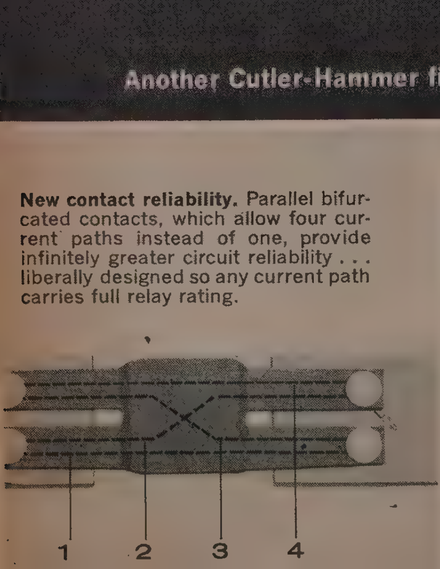
Whatever the job ... discover how Surfaceline can meet your particular lighting needs! Write Dept. 360 at Meriden, Conn., for catalog information.

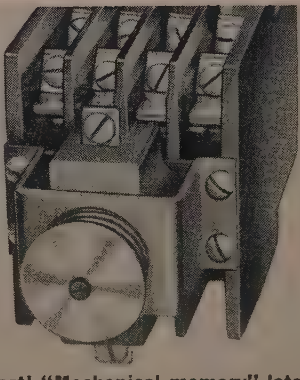
THE **miller** COMPANY
MERIDEN, CONNECTICUT • UTICA, OHIO



Another Cutler-Hammer first! Up to 24 poles in an area less than the size of a dollar bill.

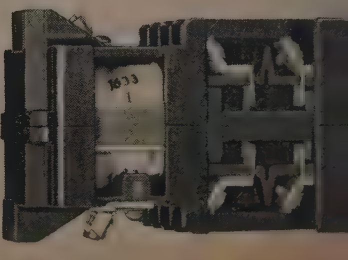
New contact reliability. Parallel bifurcated contacts, which allow four current paths instead of one, provide infinitely greater circuit reliability . . . liberally designed so any current path carries full relay rating.





At last! "Mechanical memory" latch as reliable as the relay itself! No adjustment ever needed. Add latch at any time.

New simplified design! Cutaway view shows basic simplicity. Coil vacuum impregnated to resist damage from humidity, vibration, electrical stress. Terminals can be screw or spade type.



CONTROL

Space savingest relay you've ever seen: New Cutler-Hammer "Compact 300"

Versatile 300 V. control relay is so reliable it's permanently sealed!

Here is the best answer yet to the need for an extremely reliable, small-size 300 V, 6 amp., industrial relay—the new "Compact 300" from Cutler-Hammer.

Every detail known that affects relay reliability has been improved in the "Compact 300." Bifurcated contacts which make possible *four* current paths rather than one, add millions of operations to the "Compact 300's" electrical reliability.

In fact, we're so confident of its electromechanical reliability, we permanently enclose the "Compact 300." And, if it should be damaged by a fault current, you throw it away and replace it with a new one. Its low price makes this an economical, practical maintenance procedure.

Now think of the space you can save with the "Compact 300." It controls up to eight circuits in panel space only 2″ wide by 2¾″ high. 2, 3, 4, 6 and 8 poles with any combination of N.O. or N.C. contacts are available, of course.

At any time, you can add "mechanical memory" latch with a life equal to the life of the relay. No adjustments are ever necessary. Contact your Cutler-Hammer distributor for details on the "Compact 300" or send for Pub. ED-L079-S241.

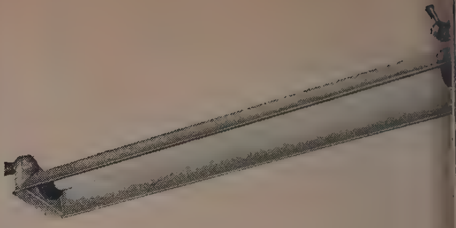
What's new at Cutler-Hammer? New, better products, like the 300 V. relay are coming steadily from our new, expanded plant facilities. We're ready now to help you take care of the great industrial growth of the future. If you are planning ahead and need electrical control assistance, contact the nearest Cutler-Hammer sales office.

WHAT'S NEW? ASK...

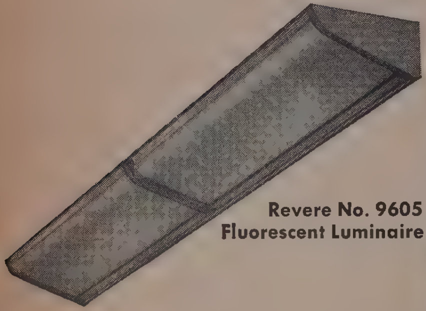
CUTLER-HAMMER

Cutler-Hammer Inc., Milwaukee, Wisconsin • Division: Airborne Instruments Laboratory • Subsidiary: Cutler-Hammer International, C. A. Associates: Canadian Cutler-Hammer, Ltd.; Cutler-Hammer Mexicana, S. A.

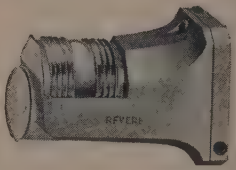
CONTROL



Revere Series 8650
"Fluoresign" Fluorescent Luminaire



Revere No. 9605
Fluorescent Luminaire



Revere No. 3151-A
Incandescent Underneath Floodlight

Widest line of fixtures lets you light store or building fronts the one best way for each job

There's one *best* way to solve each application problem in lighting store fronts or building fronts. Whichever way you decide is best for the job at hand, you'll find your Revere wholesaler has exactly the fixtures you need.

Revere makes the widest line of outdoor lighting equipment — engineered for easy installation, structurally matched for strength and balance, and design-matched for peak lighting efficiency and best appearance.

You can solve more outdoor lighting problems of any type — selecting the equipment to do the job best — knowing you can get it from Revere. Revere offers a complete line of hinged or rigid poles . . . mercury, incandescent or fluorescent luminaires . . . floodlights, fixtures and fittings. All equipment from your Revere wholesaler simplifies ordering and assures delivery of all components to your job site according to your schedule.

Ask your wholesaler about Revere outdoor lighting equipment for your next installation, no matter what equipment is called for to do the job best. Write to us for a catalog showing Revere's complete line.

Revere
ELECTRIC MFG. CO.

OUTDOOR LIGHTING

Revere Electric Mfg. Co. • 7420 Lehigh Avenue • Chicago 48, Illinois (In suburban Niles)
Long Distance Phone: NIles 7-6060 • Chicago Phone: SPring 4-1200 • Telegrams: WUX Niles
In Canada: Curtis Lighting, Ltd., Leaside, Toronto, Ontario

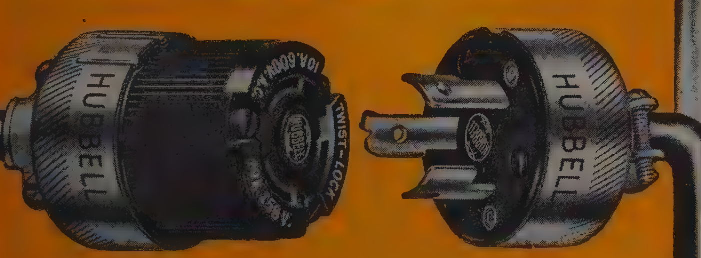
ONLY

HUBBELL

MAKES *SUPER*

Twist-Lock®

WIRING DEVICES



CAT. NO. **3323**
SUPER TWIST-LOCK
ARMORED BODY
20 AMPERES, 250 VOLTS, AC OR DC
10 AMPERES, 600 VOLTS, AC ONLY

CAT. NO. **3321**
SUPER TWIST-LOCK
ARMORED CAP
20 AMPERES, 250 VOLTS, AC OR DC
10 AMPERES, 600 VOLTS, AC ONLY

Super Twist-Lock devices are smaller, more compact and lighter in weight than regular Twist-Lock units. On the surface they look very much like their conventional brothers but actually they incorporate important construction features that place them in a class by themselves. Both the cap and connector body feature screwless pressure grip terminals which simplify and speed wiring and a revolutionary 2-piece dead front construction that seals out dust, dirt, lint, metal chips, etc. Terminals are pressure locked between the two independent sections so that all wiring is completely enclosed . . . the ultimate in wiring safety and security.

All units in the Super Twist-Lock line can be interchanged with regular Twist-Lock connectors of equal rating. This is most advantageous in industrial plants where regular Twist-Lock devices are now installed on machine tools or other equipment.

For complete information on Hubbell Twist-Lock devices, see Hubbell Catalog #29 or check Sweet's File 31b/Hu.

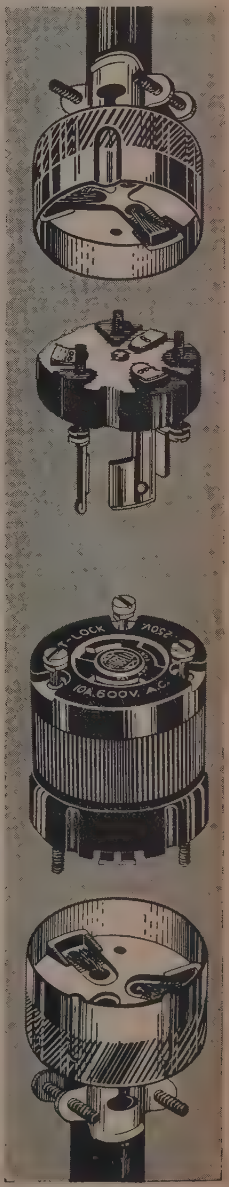
IT PAYS TO HAVE HUBBELL GOOD CONNECTIONS

HARVEY
HUBBELL
INCORPORATED
BRIDGEPORT 2, CONNECTICUT
In Canada: Scarborough, Ontario

engineering news

HARVEY HUBBELL, INCORPORATED
Engineering Department

Super Twist-Lock incorporates many advantages that contribute to substantial savings in installation time and effort. Tests also prove that it is the safest, most rugged unit of its type ever produced.



Improved Cord Grips
PROVIDE PULL-PROOF, PRESSURE-GRIP ON CABLE.

Convenient Knurled Strip Gage
SPEEDS WIRING.

Cap Shell Keyed
DIFFERENTLY FROM CONNECTOR BODY SHELL TO POSITIVELY PREVENT INTERCHANGE.

2-Piece Cap
ENGINEERED TO MAINTAIN POLARITY.

Broad Pressure Plate Contacts

Completely Dead Front
WITH NO EXPOSED WIRE ENDS TO COVER WITH FIBRE DISC. (DUST PROOF—DIRT PROOF, ETC.)

Greater Blade Rigidity . . .
ALWAYS IN ALIGNMENT, THUS MAINTAINING BETTER ELECTRICAL CONTACT.

Positive Polarity

Captive Holding Screws . . .
CAN'T FALL OUT . . . LOCKWASHERS PREVENT LOOSENING.

Heavy-Duty Bakelite
RESISTS VIBRATION AND ROUGH USAGE.

Key Slots
IN BAKELITE ASSURES PERFECT ALIGNMENT OF SPRINGS WITH SLOTS IN FACE. BLADES IN CAP FIT PERFECTLY AT ALL TIMES.

Screwless Pressure Terminals
SIMPLIFY WIRING AND PERMIT GREATER WIRING UNIFORMITY.

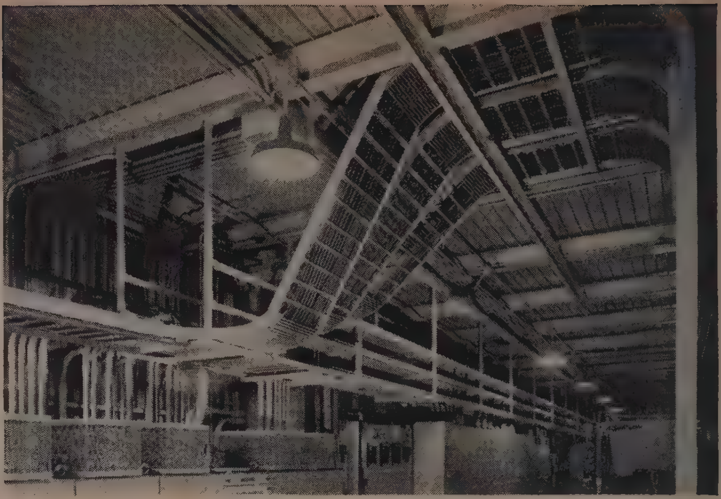
Connector Body Shell
KEYED TO PREVENT INTERCHANGE WITH CAP.

Rugged Steel Shell . . .
PROTECTS INNER CONSTRUCTION.

Twist-Lock is a registered trademark of Harvey Hubbell, Incorporated.

how INLAND STEEL uses GLOBE INTERCHANGEABLE TRAYS

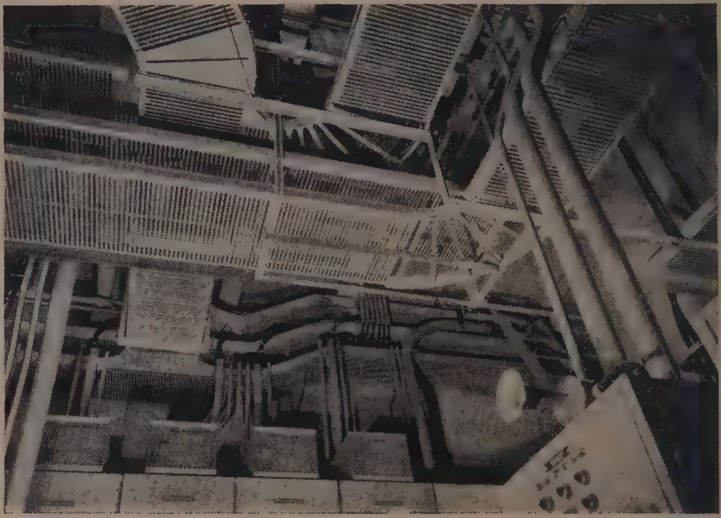
to support cables in their Indiana Harbor Plant



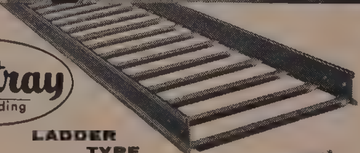
★ Engineered for Uniform Design and Easy Installation ★ Steel or Aluminum Construction

★ Complete Accessories for SPEEDIER Installation ★ Complete Interchangeability

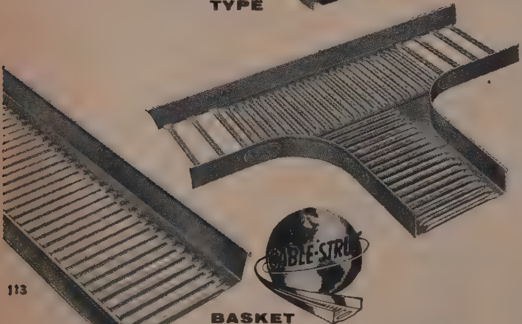
★ No Sharp Edges to Damage Cables



Globetray
Pat. Pending



LADDER TYPE



BASKET -TYPE (One-piece construction)

Globe's two types of cable trays, one a ladder type and the other a basket type, to support cables, wiring and tubing have become increasingly popular because they can be used INTERCHANGEABLY at any given location depending on the type and weight of the cables to be suspended. The advantages of each type tray can be used to the fullest. Globetray, the ladder type, is intended for use where festooning is not a problem, while Cable-Strut, the basket type, is used for the support of communication wire, instrument tubing and control cables in automation applications.

These two cable trays have been thoroughly field tested in hundreds of large industrial installations, in new plant construction, in power plants and for power distribution in all types of manufacturing processes. Send for FREE catalog giving full information and installation techniques.

PRODUCTS DIVISION
THE GLOBE COMPANY Manufacturers since 1914
4032 S. Princeton Ave., Chicago 9, Ill.

Representatives in all principal cities . . . consult the yellow pages in your phone book under "Conduits" for the one nearest you.

NEW!

FRANK ADAM

LOAD CENTERS

More Features-More Versatile!

NEW QUICKLAG MAGNETIC COIL BREAKER GIVES TWICE NORMAL SAFETY

- New coil magnet plus thermal action on 15-amp. and 20-amp. breakers has faster trip—quick enough to protect against lamp cord overload. (Coil not required on higher-rated breakers).
- Elimination of screws on calibration prevents tampering.
- New "floating armature" relieves all pressure on bi-metal element.
- Class NI Non-interchangeable per NEC.

CAPACITIES: 15, 20, 30, 40, 50 and 70 amps.

✓ **NOW**—*all* Frank Adam Load Centers have sequence bussing with main lugs at bottom which makes possible *any* combination of 2-pole circuits.

✓ **NOW**—all lugs are dual rated to allow the use of copper or aluminum wire in centers 100-amps. and higher.

✓ **NOW**—the number of branches can be greatly increased simply by the use of Frank Adam **Duplex** breakers. **Duplex** and single breakers are entirely interchangeable.

✓ **NOW**—both QP and **Duplex** breakers are Class NI Non-interchangeable per NEC.

✓ **NOW**—all these improvements are in addition to the many other features that have already made Frank Adam Load Centers tops among quality equipment. *Write for catalog.*

KEEP PACE ELECTRICALLY

See our Catalog in SWEETS

THE PRODUCERS' COUNCIL

FRANK ADAM ELECTRIC COMPANY

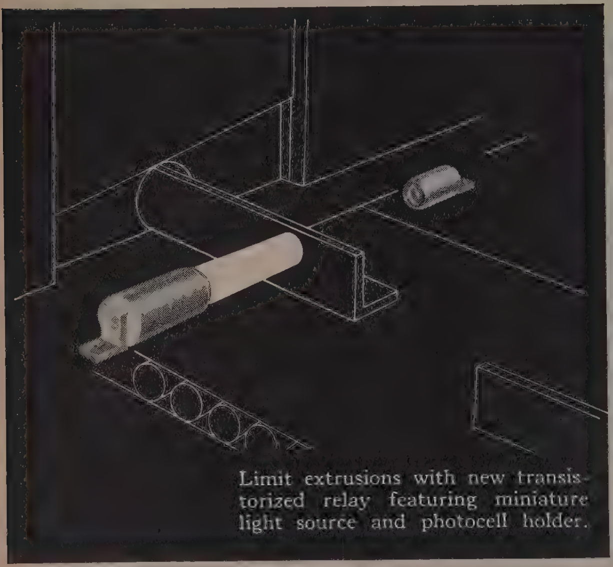
SINCE 1891

P. O. BOX 357, MAIN P. O. · ST. LOUIS 66, MO

busduct • panelboards • switchboards • service equipment • safety switches • load centers • Quikheter

FOR QUALITY . . . PRODUCTIVITY . . . PROFIT . . . MODERNIZE WITH GENERAL ELECTRIC

LIMITING

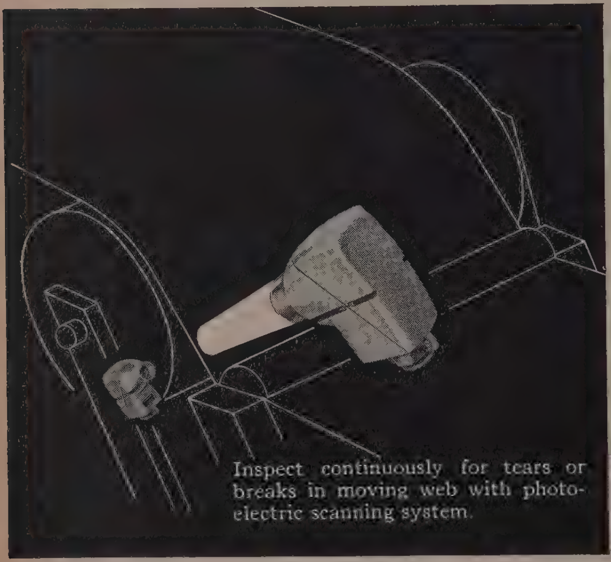


Limit extrusions with new transistorized relay featuring miniature light source and photocell holder.

COUNTING

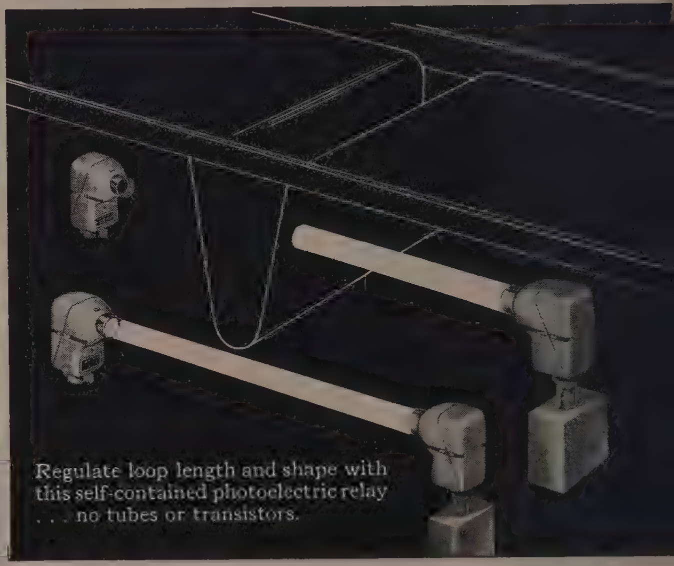
Record production without touching counted objects at speeds up to 600 operations per minute.

DETECTING



Inspect continuously for tears or breaks in moving web with photoelectric scanning system.

CONTROLLING



Regulate loop length and shape with this self-contained photoelectric relay . . . no tubes or transistors.

A COMPLETE LINE OF GENERAL ELECTRIC CONTROL DEVICES

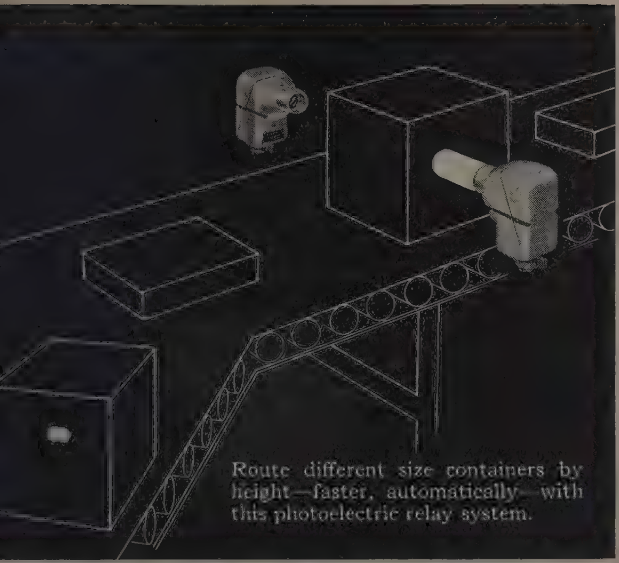
Photoelectric controls
General-purpose
High-speed
Long-distance

Electronic devices
Timers
Resistance-sensitive relays
Voltage-sensitive relays

Photoelectric systems
Smoke-density indicators
Side-register controls
Cut-off register controls

PHOTOELECTRIC CONTROLS

SORTING



Route different size containers by height—faster, automatically—with this photoelectric relay system.

SIGNALLING

Signal overheight, sound alarms, etc., automatically with this low-cost, indoor-type relay.

Switching . . . inspecting . . . counting . . . diverting . . . sorting . . . controlling. These are but a few of the *hundreds* of applications where General Electric photoelectric controls are helping our customers move closer to the benefits of automation—increased productivity, lower costs, higher quality.

Users are finding *new* ways to fit General Electric photoelectric devices into their production processes every day . . . for good reasons: These versatile G-E controls are designed for heavy-duty industrial use. They're easy to install, and require virtually no maintenance. They are highly dependable throughout a long operating life. In fact, General Electric photoelectric controls feature lamps with life expectancy of 10,000 hours—more than a year of round-the-clock operation!

ONE-YEAR WARRANTY, IMMEDIATE STOCK SHIPMENT

General Electric photoelectric and electronic devices carry a standard one-year warranty for your protection. And, your order for standard catalog devices is filled immediately from one of six regional warehouses. Also, replacement parts are warehouse-stocked, too, for your convenience and protection.

For expert help in applying General Electric photoelectric devices to your operations, call your nearby G-E Apparatus Sales Engineer or Distributor today. And, for your personal copy of our Photoelectric Devices catalog, mail the coupon below. *General Electric Co., Specialty Control Dept., Waynesboro, Va.*

SEND TODAY FOR FREE CATALOG

General Electric Co., Section G793-02
Schenectady 5, New York

Please send me a copy of the G-E Photoelectric Control catalog, GEA-6822, with description, specifications, and pricing data on the complete line.

Name ______________________

Company ______________________

Address ______________________

City ______________ **State** __________

Progress Is Our Most Important Product

GENERAL ELECTRIC

Venetian Blind Manufacturing Co., Chicago, Ill. Architect: Harold A. Stahl, Chicago, Ill. Builder: Larson & Stoneberg, Park Ridge, Ill. Electrical Contractor: Circle Electric Company, Inc., Chicago, Ill.

John R. Lauria, Electrical Contractor, uses

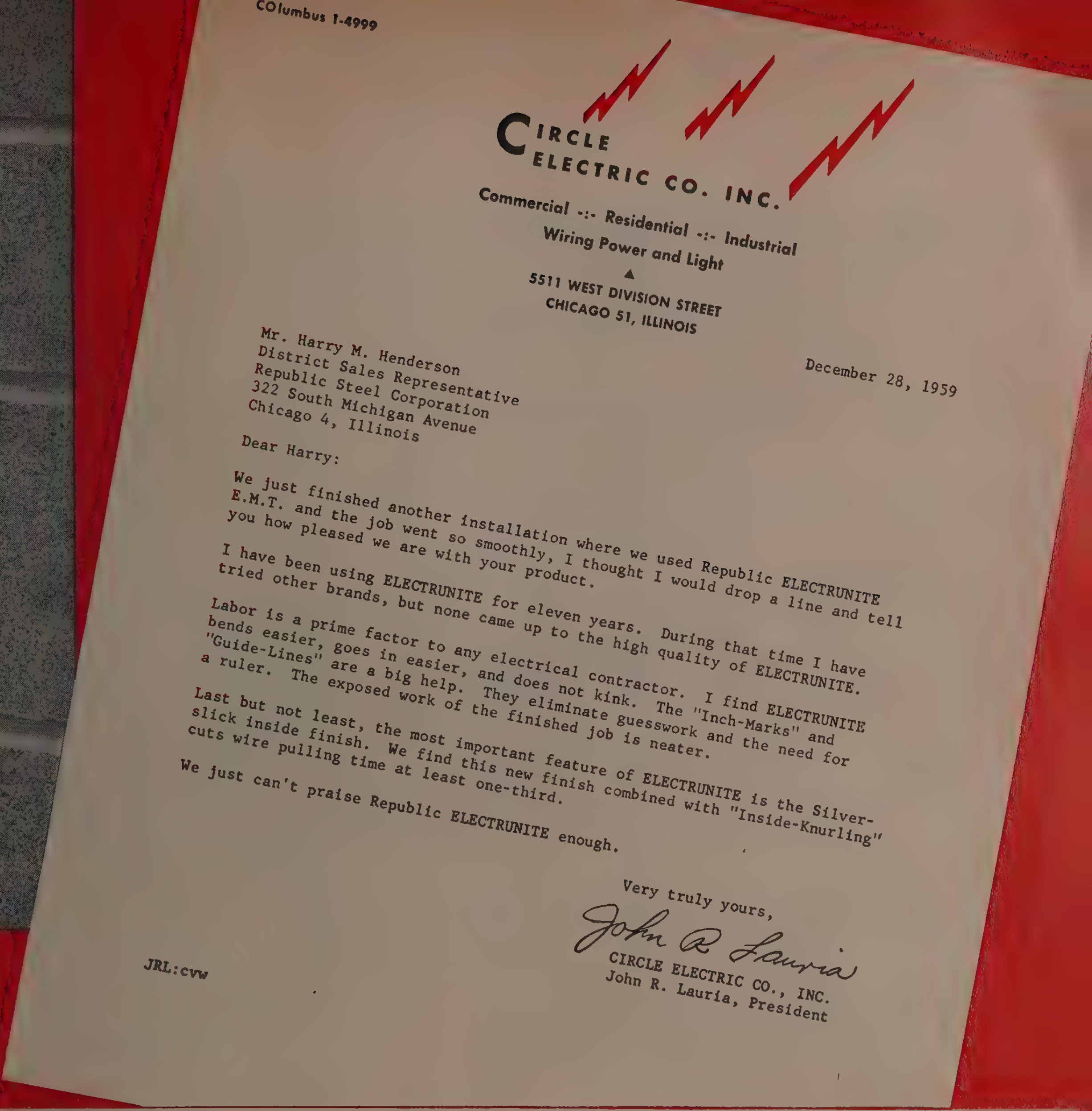
Republic ELECTRUNITE® Electrical Metallic Tubing Because...

THE BEST COSTS LESS INSTALLED

REPUBLIC STEEL
STEEL AND TUBES DIVISION
Cleveland 8, Ohio

This STEELMARK of the American Steel Industry tells you a product is made of Steel. Look for it when you buy.

To learn more about ELECTRUNITE E.M.T.–Send Coupor



COlumbus 1-4999

CIRCLE ELECTRIC CO. INC.
Commercial -:- Residential -:- Industrial
Wiring Power and Light
▲
5511 WEST DIVISION STREET
CHICAGO 51, ILLINOIS

December 28, 1959

Mr. Harry M. Henderson
District Sales Representative
Republic Steel Corporation
322 South Michigan Avenue
Chicago 4, Illinois

Dear Harry:

We just finished another installation where we used Republic ELECTRUNITE E.M.T. and the job went so smoothly, I thought I would drop a line and tell you how pleased we are with your product.

I have been using ELECTRUNITE for eleven years. During that time I have tried other brands, but none came up to the high quality of ELECTRUNITE.

Labor is a prime factor to any electrical contractor. I find ELECTRUNITE bends easier, goes in easier, and does not kink. The "Inch-Marks" and "Guide-Lines" are a big help. They eliminate guesswork and the need for a ruler. The exposed work of the finished job is neater.

Last but not least, the most important feature of ELECTRUNITE is the Silver-slick inside finish. We find this new finish combined with "Inside-Knurling" cuts wire pulling time at least one-third.

We just can't praise Republic ELECTRUNITE enough.

Very truly yours,

John R. Lauria

CIRCLE ELECTRIC CO., INC.
John R. Lauria, President

JRL:cvw

COMPLETE LINE . . . REPUBLIC ELECTRICAL CONDUIT PRODUCTS

GALVITE® RIGID STEEL CONDUIT (Blue Label) is a heavy wall hot dipped galvanized conduit with a special coat of baked-on lacquer inside and out for greater corrosion-resistance and long life.

ENAMELITE® RIGID STEEL CONDUIT (Red Label) heavy wall conduit is protected inside and out with a baked-on coating of tough, wear-resistant enamel for greater protection against moderate corrosive action.

REPUBLIC "DEKORON®-COATED" E.M.T. is the plastic armored raceway recommended for use in severe corrosive conditions of service. Outlasts standard conduit 10-to-1. Easy to install, no special tools, no special fittings.

"DEKORON-COATED" RIGID STEEL CONDUIT is the heavy wall raceway that shrugs off corrosion. Tough coating of polyethylene encases Galvite Rigid Steel Conduit in an end-to-end armor for protection in severe corrosive conditions of service.

REPUBLIC BENDING TOOLS are designed and engineered to help the contractor make accurate predetermined bends in Republic raceway installations. Avoid costly "wows", wasted time, and wasted material. Send for The Bending System Booklet.

REPUBLIC STEEL CORPORATION
STEEL AND TUBES DIVISION
DEPT. C-9381-B
212 EAST 131st STREET • CLEVELAND 8, OHIO

I want to learn more about the advantages of Republic

Name____________________Title__________

Firm______________________________

Address___________________________

NEW COMPACTNESS

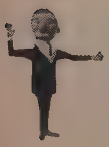
NEW SAFETY

NEW EASE OF ACCESS

NEW STORED ENERGY

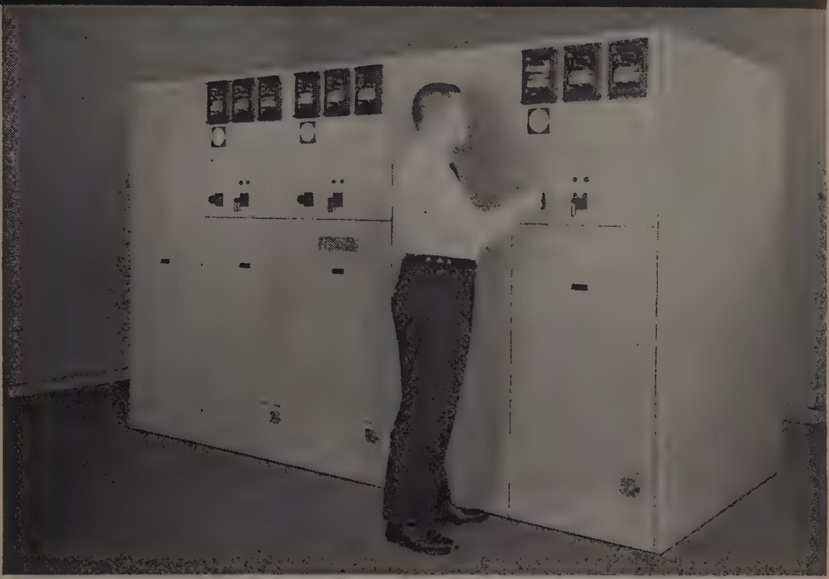
This is the all-new I-T-E
type HK metal-clad switchgear

Roomy interior for easy access. Only I-T-E gives you a separate 30-in.-high instrument compartment, completely isolated from the high-voltage compartment. And it's closer to the floor, so you can reach into it easily. Put your elbows in and work in comfort. High visibility white interiors simplify installation and trouble shooting. Your control wiring can easily enter from the bottom or through the top sheet.



Free detailed bulletin—new strip film. Get the whole story about *all* the new advances in this I-T-E metal-clad switchgear. Learn about its easier operation, greater safety, and superior protection. Send for Bulletin 2801-2A. And ask also to see the new sound strip film. Can be shown to you singly or to your group. Contact your nearby I-T-E sales office or write I-T-E Circuit Breaker Company, Dept. SW, 1900 Hamilton St., Philadelphia 30, Pa.

Fits where others won't. This is a 4160 volt switchboard. See how low and shallow it is compared with old standards. It's only 80 in. high and 58 in. deep. So it saves both floor space and overhead space. Goes easily under low ceilings. Fits in narrower aisles. And its reduced height puts all instruments at easy-to-read eye level. Roomy cable compartments at the rear are accessible through hinged doors. All insulation in the switchboard and circuit breakers is flame-retardant and track-resistant.



Closed-door drawout. The door stays closed while the breaker is moved from connected . . . through test position . . . to disconnected and back. There's always solid steel at ground potential between the operator and the live parts of the gear. Even an inexperienced man is completely safe. Since doors stay closed, aisles need never be cluttered. And foreign matter can't get into breaker compartments.

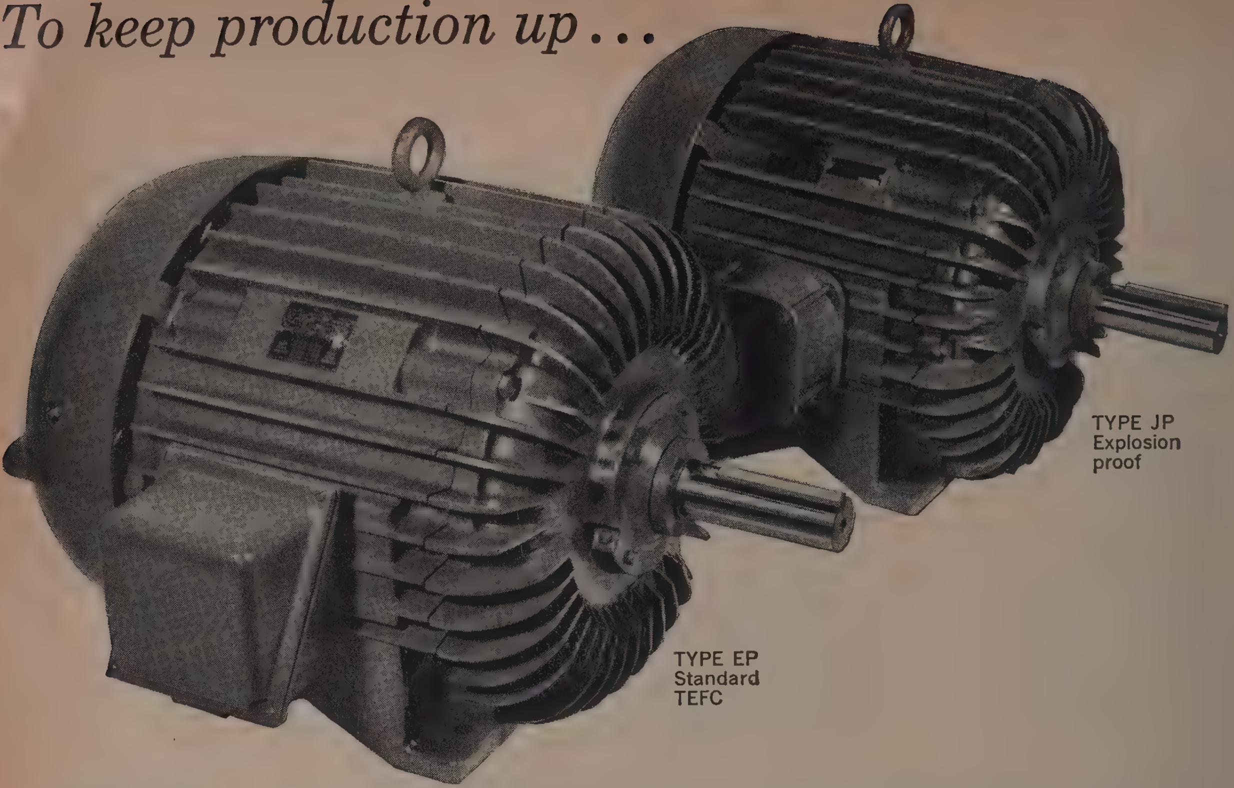
Stored energy closing. This is not simply a new feature added to an old design. It is integrated into a completely new circuit breaker design. Gives you fast, uniform closing every time. Prolongs contact life. And you can close the circuit breakers even without control power. For greater economy, the spring charging motor draws only one-tenth the current of previous methods.

Easy-to-change current transformers. They're accessible from the front. You don't need to disturb your cable connections at all. Just remove the shutter barrier assembly over the primary studs, and there they are. As this view shows, you can locate current transformers on both load and line sides of the circuit breaker, providing more flexibility in relaying.

Compact 4160 volt circuit breaker. Low center of gravity permits easy, safe, one-man maintenance. High-strength, flame-retardant track-resistant moldings eliminate need for structural metal above the base frame. Provides insulation strength where needed most. Arc chutes tilt for easy inspection. Lift off without tools. Modern materials and new design result in substantial reduction in circuit breaker size.

I-T-E CIRCUIT BREAKER COMPANY

To keep production up . . .



PICK FROM THIS PROTECTED PAIR...

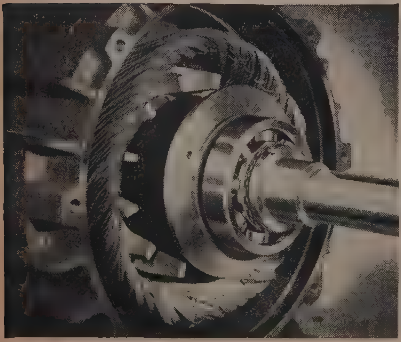
Here's a power-packed pair of Wagner® totally-enclosed fan-cooled motors —Type EP, standard, protected against damage from dust, abrasive, fumes, steel chips or filings; and Type JP, explosion-proof, for safe use in specified hazardous locations.

They'll keep your production rates up, delivering full rated horsepower under the toughest conditions . . . staying on the job with dependable, continuous service that means peak output. They're the perfect pick, for individual machines or for automated lines.

In the design illustrated, these motors are built in ratings through 100 hp in NEMA frame sizes 182-445U. Let your Wagner Sales Engineer show you how this protected pair (or larger Wagner enclosed motors through 500 hp) gets the job done. Call him, or write us for Bulletin MU-224.

Wagner Electric Corporation
6413 PLYMOUTH AVENUE, ST. LOUIS 33, MISSOURI

WM60-19

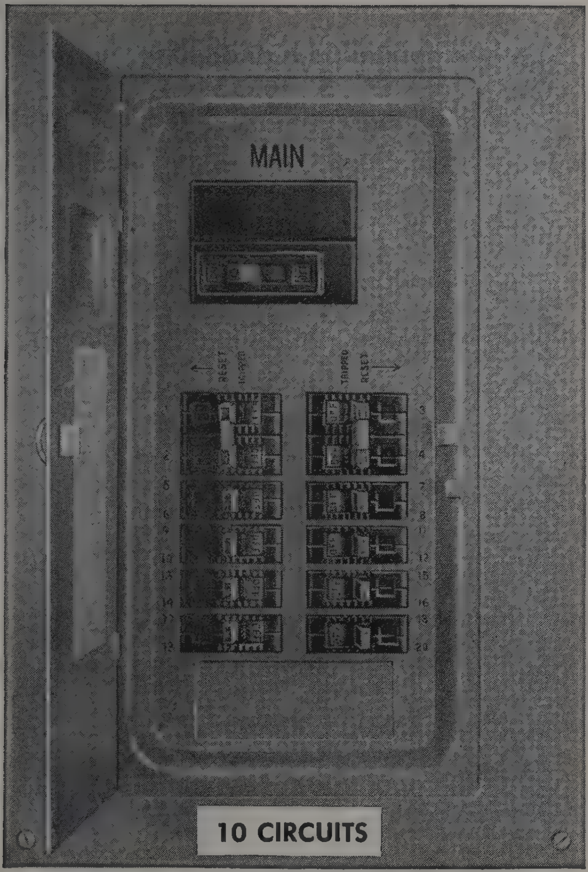


HEAVY-DUTY BALL BEARINGS . . . The ball bearings used in these motors are of the highest quality, with more than ample capacity to provide long, troublefree service under heavy loads.

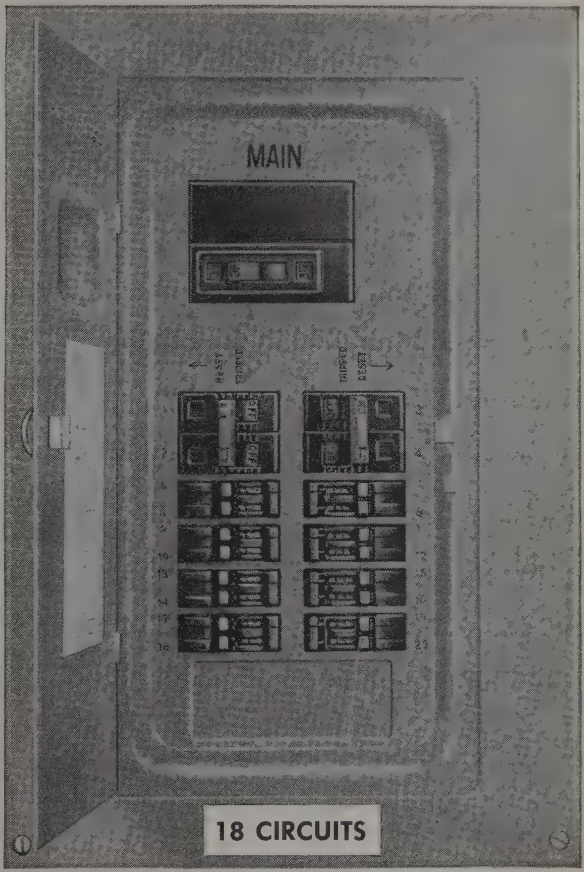
BEARINGS CAN BE RELUBRICATED . . . Factory lubrication will last for many years under normal service, but openings are provided to permit relubrication that adds years to motor life under severe conditions.

SECURELY SEALED FOR LOW MAINTENANCE . . . Both ends of these motors have running shaft seals to keep the bearings clean. Bearing housings are effectively sealed to prevent escape of grease.

Same box - 8 extra circuits



General Electric TRM1210S "twin"* load center wired with two double-pole TQL plug-in breakers and eight single-pole plug-in TQL's.



Same load center wired with two double-pole TQL's and *sixteen* General Electric Type TR "twins" — two rugged breakers in a one-inch case.

Install more circuits, buy a less expensive box, with

General Electric "twin" circuit breakers

The "twin" lets you put up to twice as many circuits in the same space—because the "twin" is actually *two* rugged plug-in breakers in a single one-inch case.

Combined with other top-quality G-E breakers, the "twin" gives you complete flexibility in circuit arrangements. It is interchangeable with General Electric Type TQL single-pole and 2- and 3-pole common-trip breakers. Ask your G-E Distributor to show you how General Electric's "twin" can save you money on your next job.

*Trade-Mark

NEW

70 and 100-amp plug-in breakers

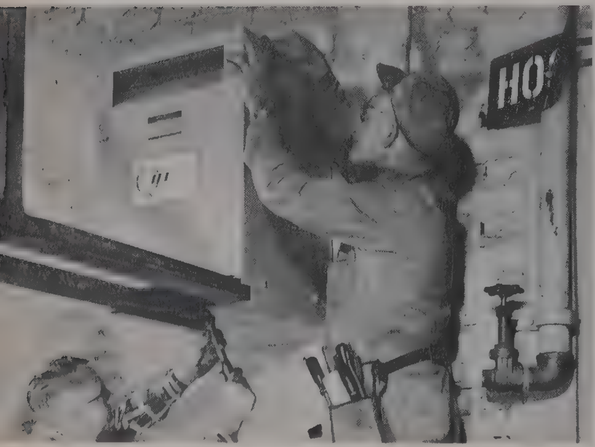
Perfect for sub-feed panels or main disconnects (back-fed). Protected female stab receptacles grip tightly; can't bend; plug-in without jiggling. All current-carrying parts silver-plated for cool, safe operation.

MEDALLION HOME LIVE BETTER ELECTRICALLY

PROTECTING MEDALLION HOMES EQUIPPED BY GENERAL ELECTRIC

GENERAL ELECTRIC

Transformers are shipped on pallets which makes it easy for you to use a fork truck to position General Electric QHT dry-type transformers for mounting.



Keyhole slots hold QHT transformer in place. Built-in mounting provisions eliminate need for wall brackets.

Hook up this General Electric QHT transformer in only 18 minutes

You save time and money every time you install a General Electric QHT dry-type transformer.

First, QHT transformers are easy to handle. They offer savings up to 50 percent in weight and 67 percent in size compared with other dry-types. You can place QHT units near the load and save the cost of long, low-voltage feeders. They don't require vaults, barriers, or ventilating fans.

Entire front panel is removable to expose all terminal and tap connections. All connections are up front.

Second, you wire QHT transformers from the front. There's a complete wiring diagram on the nameplate. Dual-sized conduit knockouts are placed so that you can run cable straight into the connectors. And large, roomy terminal compartments, solderless connectors, and numbered terminals help you to complete wiring in 18 minutes.

The new General Electric QHT dry-types are quiet—at least 15 decibels quieter than older designs, making them ideal for schools, hospitals, office buildings, and other places where noise could be a problem. All QHT units have sound ratings equal to or less than NEMA standards. On larger units, welded steel clamps minimize core vibration. The core assembly is mounted on built-in rubber pads to reduce noise transfer through conduits and mounting brackets.

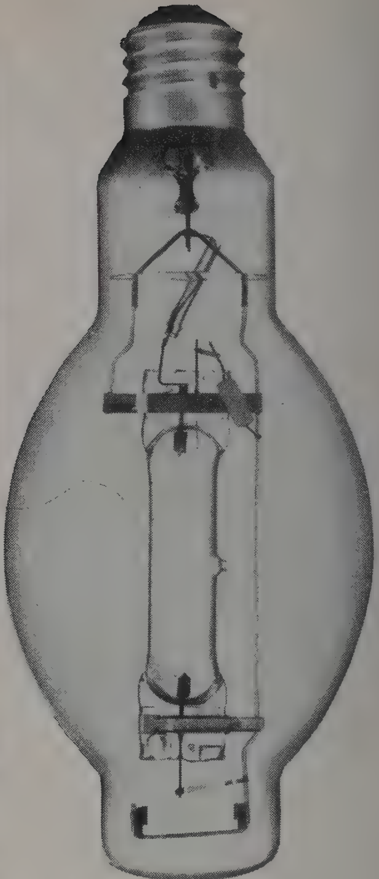
You can get 24 hour delivery on most models from your nearby General Electric distributor. For more information, call him today or write to Section 411-17, General Electric Co., Schenectady 5, N. Y.

* Registered trademark of General Electric Co. for quiet, high-temperature dry-type transformers.

Progress Is Our Most Important Product

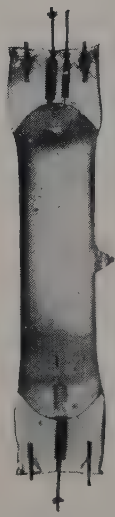
GENERAL ELECTRIC

6000 USEFUL HOURS EXTRA



New G-E "Bonus Line" Mercury Lamps. 6000 extra hours! That's the bonus your customers get in every 400-watt G-E "Bonus Line" Mercury Lamp . . . and a minimum of 3,000 hours extra in the other wattages. One look at these two light-producing arc tubes and you can see why General Electric "Bonus Line" Mercury Lamps are their best bargain. See how the one from a G-E Lamp stays white? That's because its special electrode doesn't deposit a *black* coating, but a translucent *white* coating that lets the light come through. The result: your customers get as much light at *9,000* hours as ordinary mercury lamps give at *3,000* hours. General Electric "Bonus Line" lamps now available in *all* sizes from 100 to 1,000-watts . . . in all popular shapes and "colors" . . . *at new low prices.*

Men in the know . . . know they get important differences when they specify General Electric Lamps—whether they're mercury, filament or fluorescent. So let your General Electric Lamp distributor explain the important plus you can get in the lamp types you use. General Electric Company, Large Lamp Department, C-033, Nela Park, Cleveland 12, Ohio.

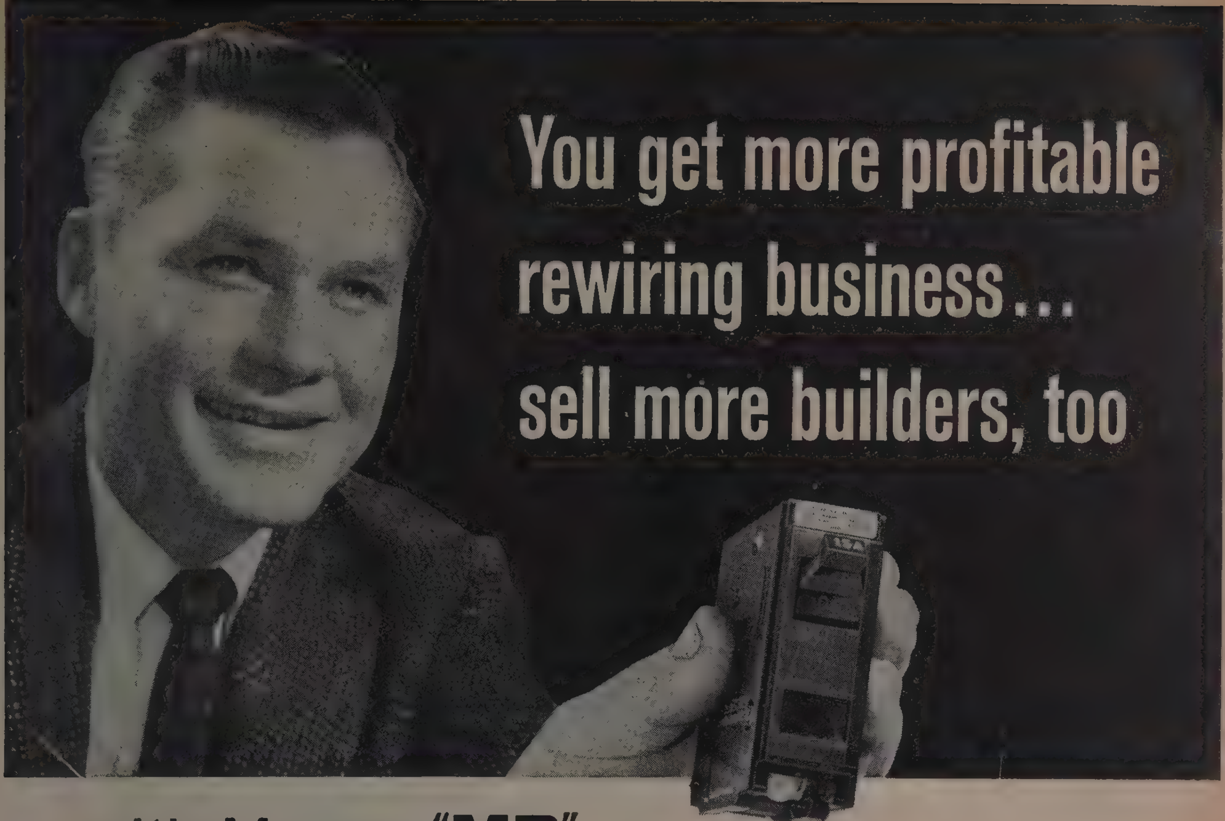


BONUS
ARC TUBE
AFTER
8000 HRS.

ORDINARY
ARC TUBE
AFTER
8000 HRS.

Progress Is Our Most Important Product

GENERAL ELECTRIC



with Murray "MP" GUARANTEED FOR LIFE Breakers

Why squeeze profits on rewiring jobs, when you can more easily sell quality jobs at profitable prices. By offering customers a breaker that's *guaranteed for life,* you win confidence, make your sales job easier.

Homeowners appreciate knowing that the breakers you install carry a *life guarantee*...won't quibble so much about price. Here's another advantage: the guarantee shows you're using the best, helps you build prestige in your neighborhood.

Extra Sales Advantage!
Builders, too, go for the *lifetime "MP" breaker guarantee.* It helps them sell against homes with less quality, gives them an extra sales edge in today's competitive market.

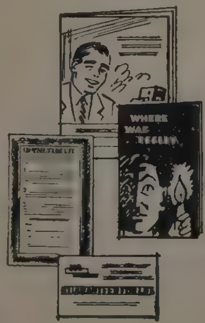
Show builders how "MP" breakers can turn more lookers into buyers... and you've practically made the sale.

Easy To Install!
"MP" breakers are *fully magnetic.* They're unaffected by heat, never need derating, never trip unnecessarily, carry full rated load...and can be installed anywhere. You'll find jobs going up easier, faster...and at minimum expense. And there's an enclosure for every job in Murray's full line of load centers.

How To Cash In!
See your Murray distributor today. Ask him to show you all the promotional material he has available to help you sell. Or write Murray directly for details. Do it today.

These money-making sales aids help you sell more "Guaranteed For Life" breakers:

Guarantee Certificate
Load Center Sticker
Consumer Booklet
Builder Brochure



60TH YEAR
Murray

Murray Manufacturing Corp., 1250 Atlantic Avenue, Brooklyn 16, N.Y.

Gentlemen:

A circuit breaker that's *Guaranteed For Life!* I'm interested. As soon as possible, send me complete information on everything.

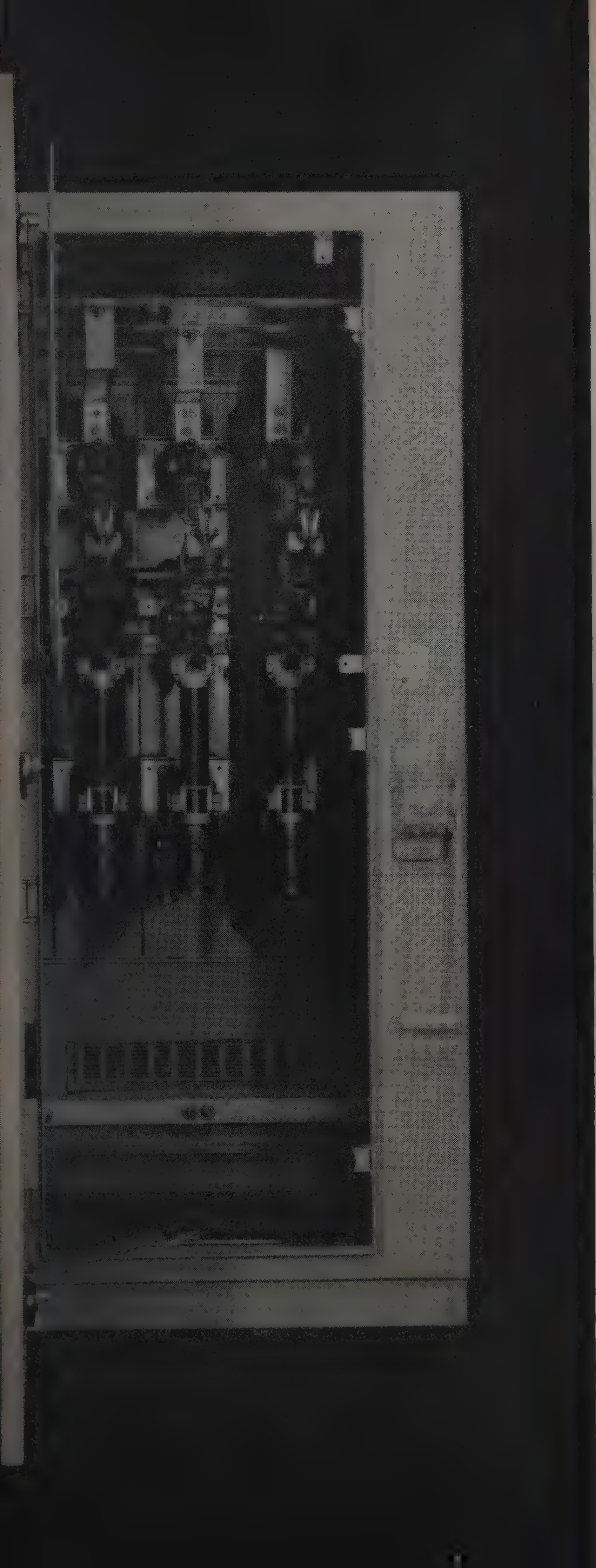
Name________________________________

Address________________________________

My wholesaler is________________________________

HOW SIMPLE CAN YOU GET?

S&C metalclad switchgear meets all National Electric Code requirements for fault closing, short-circuit interruption. Performance proved by high power testing at KEMA laboratories.



S&C metalclad switchgear is easy to operate, easy to maintain, easy to understand

The simplicity of the fused interrupters in S&C metalclad switchgear means that everyone from the consulting engineer to the electrical contractor to the plant engineer and electrician saves time, money, and effort. The power fuses give positive and permanently accurate protection against faults. The load interrupters provide full load switching and can close on any fault up to 60,000 amps (at 4.16 kv). The power fuse in series with the load interrupter takes the mystery and high cost out of high-voltage switch-gear for industrial plants and for commercial and industrial buildings.

Costing roughly half the price of comparably rated circuit-breaker equipment, S&C metalclad switchgear protects high-voltage power supply circuits with self-sufficient power fuses. Permanent faults are detected without the complicated relay systems or instrument transformers required with circuit breakers. (Transient faults do not occur on industrial or commercial power supply circuits. Thus the expensive repetitive and automatic reclosing features of circuit breakers are not needed.) After the fault has been corrected, simply replace the blown fuse with a $13.50 refill stored right in the enclosure door.

Operating instructions and installation are simple with S&C metalclad switchgear. Nothing to set, adjust, exercise or check out. Plant personnel find it easy to understand and operate.

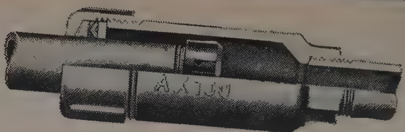
Why not consider S&C metalclad switchgear for your high-voltage (2300 to 15,000-volt) power systems? For more information, please consult the telephone directory for your nearest S&C sales office. Or write to:

S & C ELECTRIC COMPANY
4433 Ravenswood Avenue • Chicago 40, Illinois
Specialists in High Voltage Circuit Interruption since 1911

S&C

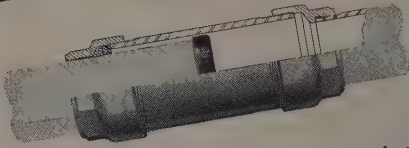
in the long run... it's O.Z.

Type AX



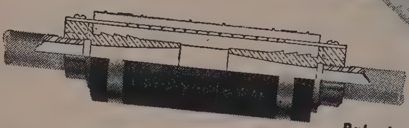
Provides 4″ expansion, contraction movement. Malleable iron head, body Hot Dip Galvanized. Weatherproof head sealed by factory-installed high grade graphite packing. Insulating conduit end bushing eliminates cable abrasion. 10 sizes for conduit ½″ to 4″ diameters.

Type EX



Permits 8″ conduit movement. Optional length sleeves, additional cost. Weatherproof head sealed by factory-installed high grade graphite packing. Insulating bushings prevent cable abrasion. Hot Dip Galvanized finish. 12 sizes for ½″ to 6″ conduit diameters.

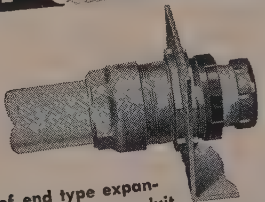
Type DX



Patented

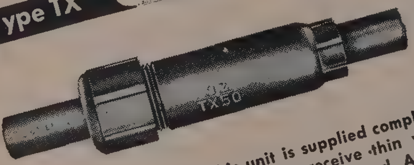
Compensates for deflection, expansion, contraction. ¾″ movement all directions from normal; 30° angular movement. Also used as vibration damper between conduit sections. 10 sizes. Watertight (NEMA 4) and submersible under 25 ft. head of water.

Type EXE



Weatherproof end type expansion fitting. Designed for conduit terminating in junction box, where expansion, contraction take place. Supplied complete: locknuts, bushings. Standard finish, Hot Dip Galvanized. 12 sizes.

Type TX



Similar to the Type AX, this unit is supplied complete with extension nipples, ready to receive thin wall couplings. Standard finish is cadmium plated. Available in 6 sizes for conduit ranging from ½″ to 2″.

for the longer line of EXPANSION FITTINGS

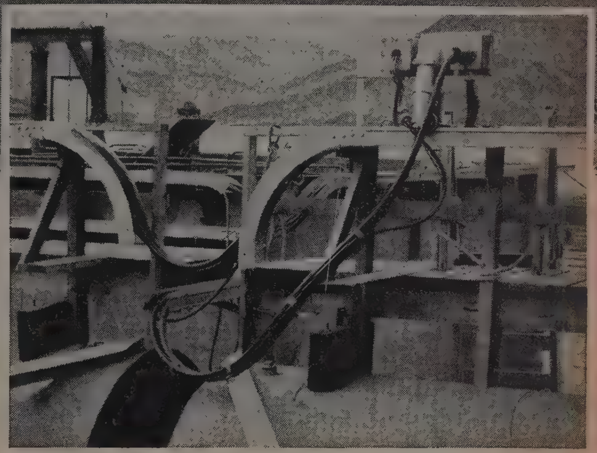
In the long run, no line of conduit is more dependable than its components. When it comes to dependability in expansion fittings, look to O. Z. as the line that measures up! Five basic types provide the dependable answer to your fitting problems in conduit expansion, contraction, and deflection. O. Z. is the dependable line because it's the line with the *right size*, the *right type*, for every requirement! Types AX, DX, EX and EXE available in aluminum at no extra cost.

O.Z. ELECTRICAL MANUFACTURING CO., INC.
262 BOND STREET • BROOKLYN 17, N. Y.

- CAST IRON BOXES
- CABLE TERMINATORS
- POWER CONNECTORS
- SOLDERLESS CONNECTORS
- GROUNDING DEVICES
- CONDUIT FITTINGS
- INTERLOCKED ARMOR CABLE FITTINGS

Sales Office and Warehouse: 406 So. Cicero Avenue, Chicago 44, Ill. • ESterbrook 9-0326
Office and Factory: 749 Bryant Street, San Francisco 7, Calif. • GArfield 1-7846

THIS IS THE "FISH NET"—stretching more than a half-mile across the reservoir behind Idaho Power Company's Brownlee Dam in the Hells Canyon reach of the Snake River, bordering Idaho and Oregon. The migrant fish facility, designed to save salmon and steelhead from a drop over the spillway of the 395-foot-high Brownlee Dam, depends on Okolite-Okoprene 600-volt power and control cable for continuous, all-weather operation. Fish trapped at three skimmer-barges attached to the net are taken by specially designed trucks for release down-river.



HERE IS CABLE'BILITY on the job, providing power to two 21,000-gallon-per-minute pumps which create artificial currents that lure the fish into channels in the trap. Multi-conductor control cable also enables a complicated maze of control equipment—almost completely automated—to be operated both from the barges and a shore station.

Cable'bility at work

Idaho Power chooses Okolite-Okoprene cables for power and control at "world's biggest fish net"

Cable'bility (cā'ble·bil'·i·ty) *new word. Noun.* **1.** Ability to design and manufacture electrical cables that give outstanding performance. **2.** Having long background and wide experience in cable research and application. **3.** Possessing keen understanding of customers' problems. Implies eagerness to serve faithfully and dedication to progress. **Syn.** The Okonite Company.

Okolite-Okoprene 600-volt power and control cable is at the heart of Idaho Power's new fish conservation facility behind Brownlee Dam in Hells Canyon, on the Idaho-Oregon border.

The "world's biggest fish net"—300,000 square feet in size behind the giant Snake River dam—depends on nine-conductor Okolite-Okoprene control cables to carry current to almost completely automated control equipment. And Okolite-Okoprene three-conductor power cables provide power to motors driving two 21,000-gallon-per-minute pumps which create artificial water currents, luring fish into channels in the trap.

Both Idaho Power and International Engineering Company, the consulting engineers, specified Okolite-Okoprene for the project, seeking maximum operating dependability. The cables are constantly exposed to weather and, in the center section, are submerged in water. Their flexible stranding helps them withstand the movement of the barges on the lake, as well as handling during removal of barge sections or traps.

For the full story on Okolite-Okoprene, write for Bulletin EC-1085. The Okonite Company, Subsidiary of Kennecott Copper Corporation, Passaic, N. J.

where there's electrical power . . . there's **OKONITE CABLE**

7228-A

FOR HIGH EFFICIENCY, LOW-COST LIGHTING

2½ TIMES MORE LIGHT AT THE WORK LEVEL

For high bay installations using standard fixtures, the Westinghouse Narrow Beam Incandescent Lamp with built-in reflector delivers 2½ times more foot candles at the work level than conventional broad beam reflector lamps. Cleaning is unnecessary since dust on bulb can't absorb light. In 500, 750 and 1,000 watt sizes.

The high efficiency lamps shown above demonstrate the ability of Westinghouse to reduce lighting costs. In the Westinghouse line you'll find the correct lamp to give you one or more of the following benefits: greatest savings in lamp purchases; lowest maintenance cost; the most light at the same or lower cost; the most efficient use of power. Call your Westinghouse Lamp Representative today. You can be sure . . . if it's Westinghouse.

Westinghouse Lamp Division, Westinghouse Electric Corporation, Bloomfield, New Jersey

...CHOOSE WESTINGHOUSE LAMPS

UP TO 60% GREATER USEFUL LIGHT OUTPUT

Because it directs 60% more light downward than conventional types, the Westinghouse Reflector Fluorescent Lamp is ideal for displays and work areas. Comes in bi-pin and single pin types. The latter can be rotated for precise light control. Built-in reflector cuts maintenance. In 48 and 96 in. sizes; 40 and 90 watts.

UP TO 20% MORE LIGHT THAN OLDER TYPES

Besides delivering up to 20% more light at the work level, Westinghouse Lifeguard Mercury Lamps maintain up to 86% of initial output after 9,000 hours of use and provide 12,000 hours of high light output. Lifeguard Arc Tube prevents darkening of glass with ensuing loss of light. In the long run, this is the most economical lamp you can buy. In 400, 700 and 1,000 watts.

Westinghouse

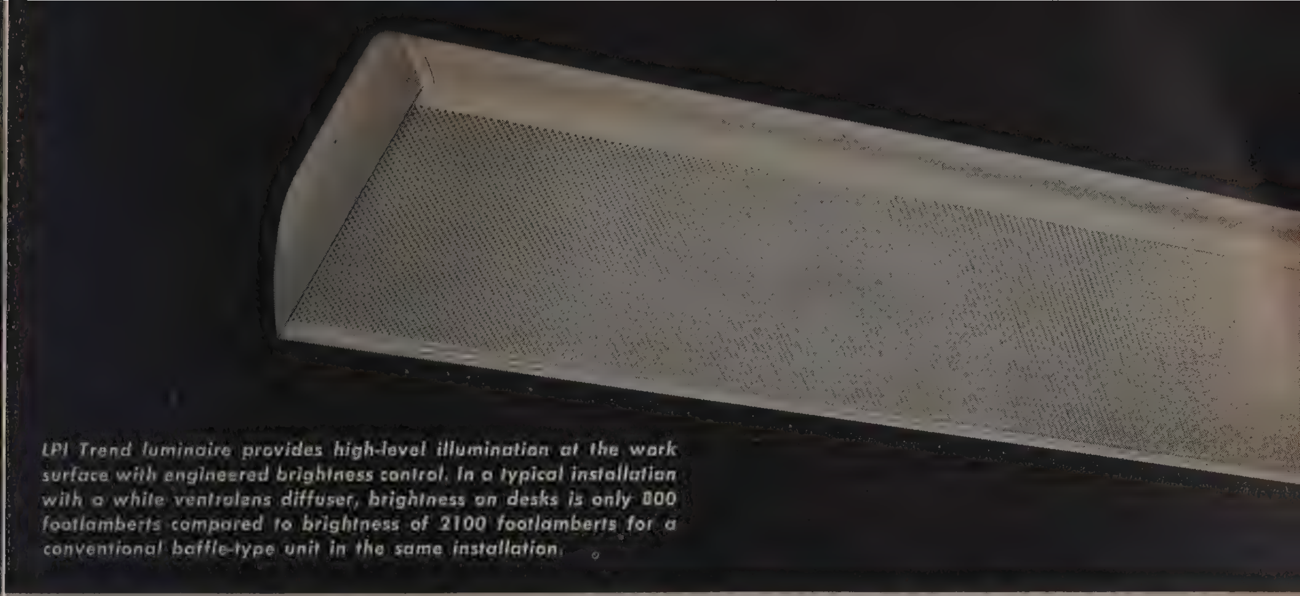
CIRCLE F's new "Smoothie" Wall Plates—smooth and clean in design—are ideal for residential, commercial and institutional applications. The completely smooth surface prohibits dust and dirt accumulation and makes these plates ideal for painting. The simple classic design with its compound parabolic curves blends well with modern or any other decor.

Moulded of non-combustible non-absorbing thermosetting plastic all Smoothie Wall Plates have reinforced rib construction to give added strength and eliminate warping. All Smoothie plates are individually packaged in cellophane and have an envelope containing mounting screws sealed in the package.

See your distributor or write us direct.

CIRCLE F MFG. CO.

TRENTON 4, NEW JERSEY



LPI Trend luminaire provides high-level illumination at the work surface with engineered brightness control. In a typical installation with a white ventrolens diffuser, brightness on desks is only 800 footlamberts compared to brightness of 2100 footlamberts for a conventional baffle-type unit in the same installation.

New LPI Trend luminaire provides high-level illumination, meets recommendations for visual comfort

Visual comfort at high illumination levels is now attainable in schools and offices with the new, economical LPI Trend series.

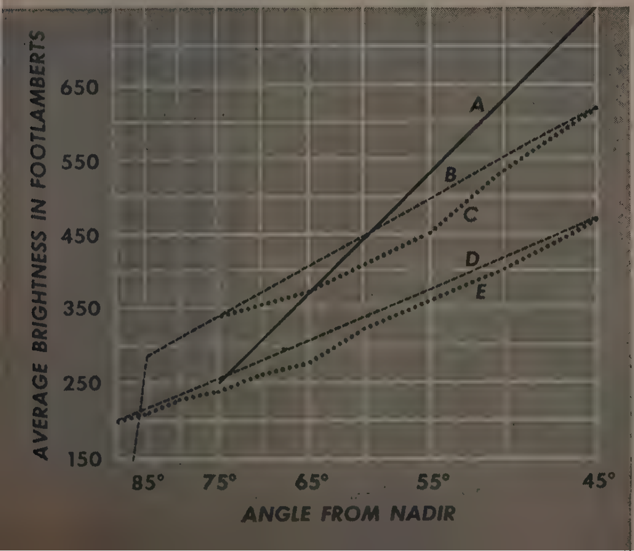
The design of the Trend luminaire combines luminous side panels with efficient diffusers. Both are engineered in shape and transmission characteristics to provide increased foot-candle levels while closely approximating the Illuminating Engineering Society's "scissor curve" for visual comfort.

The new design with luminous, wrap-around side panels makes the Trend luminaire efficient and attractive. Direct glare is well below levels commonly associated with conventional fixtures. The series offers a choice of three types of diffusers—clear ventrolens, white ventrolens to achieve minimum reflected glare, and a new polystyrene egg crate louver which provides 55° shielding both crosswise and lengthwise.

Trend series luminaires are offered in the following sizes for 430 ma rapid-start lamps: 4 ft. x 12 in. unit for two lamps; 8 ft. x 12 in., tandem arrangement for four lamps; 4 ft. x 16 in. for four lamps.

Visual comfort of the new Trend luminaire is depicted in the adjoining chart according to the "scissor curve" method recommended by the Illuminating Engineering Society. Average brightness levels are obtained in the crosswise and lengthwise directions at angles between 45° and 90° from nadir and are plotted on a chart. Also plotted is a straight line representing the I.E.S. recommended brightness limit and straight lines representing the luminaire's own brightness limits in the two directions. Because brightness measurements of the Trend luminaire in the critical crosswise direction fall below these lines, the luminaire may be said to meet I.E.S. recommendations for crosswise brightness control. Lengthwise measurements closely approach these recommendations and are well within the comfortable range.

For complete information on these attractive, moderately priced luminaires, write for LPI's Trend Bulletin.



LPI FLUORESCENT LIGHTING

Lighting Products Inc., Highland Park, Illinois

Plot of average brightness in footlamberts in plane normal to lamps (crosswise of luminaire) and plane parallel to lamps (lengthwise of luminaire) for pendant-mounted LPI Trend luminaire—Catalog No. 7840-4, with CBM ballast and two F40T12/CW/RS lamps

A—*I.E.S. recommended brightness limit (75°-45°)*
B—*Trend luminaire brightness limit—lengthwise*
C—*Trend luminaire average brightness—lengthwise*
D—*Trend luminaire brightness limit—crosswise*
E—*Trend luminaire average brightness—crosswise*

NOW *. . . a simple, effective, low cost method of preventing electrical failure due to moist and corrosive atmospheres*

Failure of physical or electrical characteristics of electrical and electronic equipment is often due to moisture and corrosion. Without effective moisture protection, deterioration sets in, leading to costly downtime, expensive repairs and high replacement incidence.

Dual-action CRC 2-26 eliminates or greatly reduces these failures. It displaces moisture on surfaces—gets into grain boundaries, cracks and pores—and leaves a thin, continuous molecular film that both stops and prevents corrosive action on metals, plastics, rubber, plated and painted surfaces.

Dimensional characteristics, contact resistance and other electrical constants remain unchanged. CRC 2-26 does not become dry, brittle or hard. Because it is non-irritating, non-toxic and has a high flash point, CRC 2-26 is easily applied without special precautions. It is used to maintain equipment year after year that formerly burned out or needed extensive servicing every few months.

Write for complete information to Corrosion Reaction Consultants, 116-A Chestnut St., Philadelphia 6, Pa., or telephone WAlnut 5-0200.

A SUBSIDIARY OF THE CHAS. J. WEBB SONS CO., INC.

Place your order now with your Electrical Distributor

CRC® FORMULA 2·26

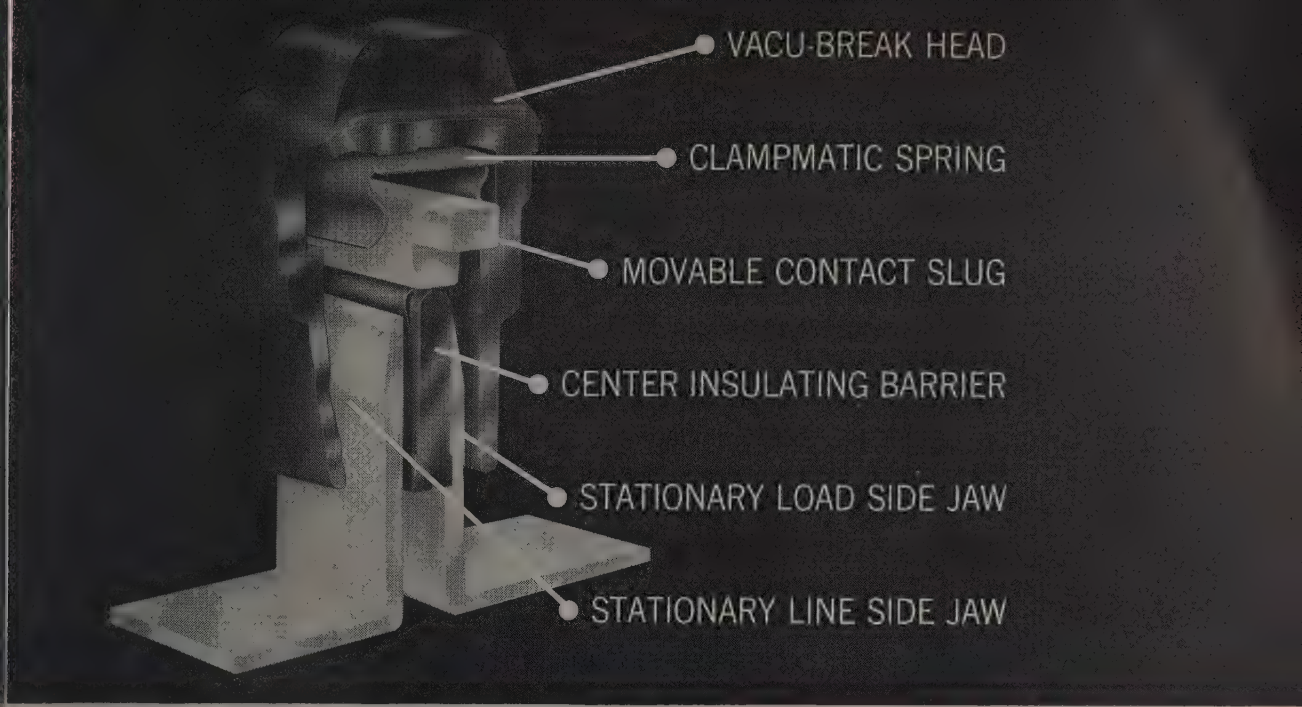
FOR THE ELECTRICAL INDUSTRY

TYPICAL EQUIPMENT MAINTAINED BY CRC 2-26

Switchgear
Circuit breakers
Contactors
Fuses
Relays
Solenoids
Rectifiers
Transformers
Instruments
Motors
Generators
Cables
Insulation
Coils
Timers
Conduits
Fixtures
Panelboards
Blowers
Signals
Controls
Recorders
Shielding
Counters
Housings
Chassis
Oscillators
Rheostats
Sub-assemblies
Synchronizers
Transmitters
Receivers
Ignition systems
Microphones
Tubes
Welders

Supplied in 16 oz. aerosol cans, 1 and 5 gal. cans, 55 gal. drums

CRC® 2·26 LOW COST PROGRAMS FOR PREVENTIVE MAINTENANCE



THE INSIDE STORY...

Why switches last longer with clamped pressure contact and Vacu-Break arc control

This BullDog Vacu-Break® Switch Head is the reason why Vacu-Break switches stay in action longer.

See how the unique Clampmatic® spring clamps the contact slug firmly between the line and load jaws . . . provides a virtual bolt-tight connection! This clamped pressure contact prevents overheating while in the "on" position—and as the switch moves to "off," the spring speeds the break. Both features mean longer switch life for your customers.

Equally important to longer switch life is the action of the Vacu-Break head. Arc chambers enclose the switching contacts. When contacts are broken under load, arcs are smothered quickly. Pitting and burning are cut to the absolute minimum, thereby minimizing maintenance.

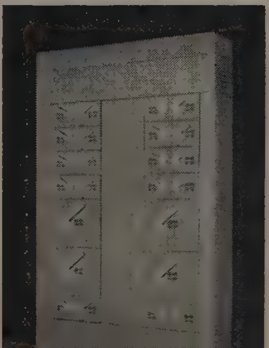
BullDog Electric Products Division, I-T-E Circuit Breaker Company, Box 177, Detroit 32, Michigan. In Canada: 80 Clayson Rd., Toronto 15, Ont. Export Division: 13 East 40th St., New York 16, N. Y.

For Safety's Sake Buy Vacu-Break

BULLDOG ELECTRIC PRODUCTS DIVISION
I-T-E CIRCUIT BREAKER COMPANY

KEEP PACE ELECTRICALLY

Vacu-Break switch units with clamped pressure contacts are available in BullDog Safety Switches, Switchboards, Vacu-Break Power Panels and Bus Plugs. They cost no more and give your customers the maximum in safety and performance. See your BullDog distributor.



1

SPECIFY CLIFTON CONDUIT

The conduit with built-in quality

1 **EMT** (Electrical Metallic Tubing) the only hot-dipped galvanized tubing—inside and out for complete protection •flat, clean, continuous weld for smooth interior surface and ease of pulling during installation.

2 **RIGID CONDUIT** made of the finest steel available • Clifton's exclusive process for hot-dipped galvanizing guarantees a uniform zinc protective coating ...inside and out • the finest rigid conduit made. Clifton Rigid Conduit is approved by Underwriter's Laboratories, Inc. and conforms with Federal Specification WW-C581C and ASA Specification C-80.1-1953. Clifton EMT is approved by Underwriter's Laboratories, Inc. and conforms with Federal Specification WW-T-806B and ASA Specification C-80.3-1953. RIGID CONDUIT ELBOWS, COUPLINGS, AND NIPPLES in a full range of sizes • are manufactured of the same fine high quality steel as RIGID CONDUIT • hot dipped galvanized inside and out.

3 **FLEXIBLE STEEL CONDUIT** really flexible and crush-resistant for easier and faster installations • manufactured under Clifton's rigid controls from purchase of high quality steel tape to finished product • smooth inside surface assures you trouble free pulling during installation. Clifton Flexible Steel Conduit is approved by Underwriter's Laboratories, Inc. and conforms with Federal Specification WWC-556. Other quality products by Clifton: Bushed Armored Cable; Unarmored Service Entrance Cable; (CLIFTX) Non-Metallic Sheathed Cable; CLIFTALL-UF; Building Wire —TW, RHW, RR.

CLIFTON CONDUIT CORPORATION
A Division of General Cable Corporation
3300 Eastbourne Ave., Baltimore 24, Md.

2

3

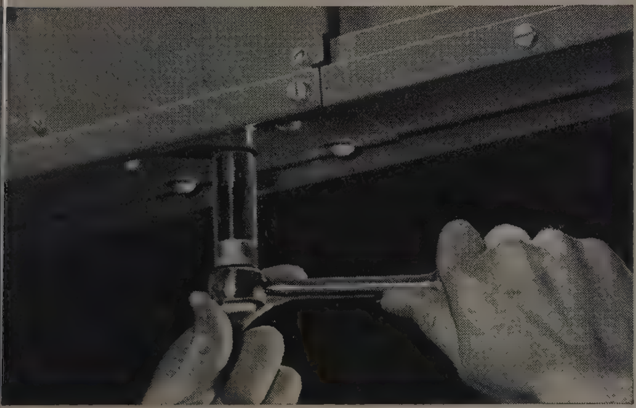
NEW BULLDOG XL BUSTRIBUTION DUCT

CUTS INSTALLATION TIME 3 WAYS

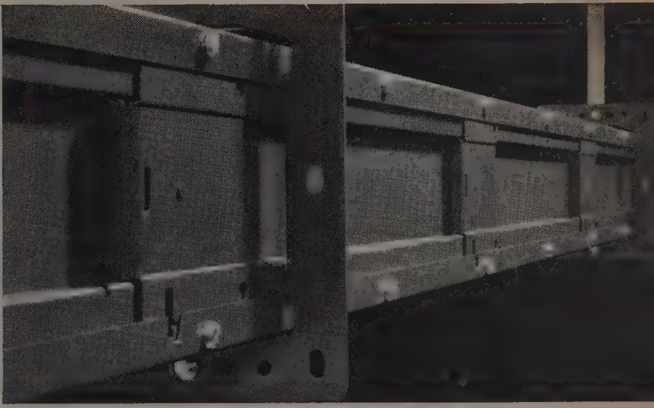
You can install XL BUStribution® Duct easier, faster than any other duct because of these exclusive new design features . . . plated aluminum bus bars with KEYED ENDS slip together fast, align automatically for proper position. There's no fumbling and fitting . . . ONE INTEGRAL BOLT tightens fast, locks joint positively under a ton of pressure. Bolt tightens against bus bar, not against the casing . . . TEN-FOOT SPANS take fewer hangers and less time to install than ordinary duct.

New XL BUStribution Duct is 3 ways safer, too. It's the only true dead-front duct, the only one with exclusive Safety Door, the only one with Safety Plug. And it reduces duct weight on building structure as much as 40%. Ask your BullDog distributor to arrange for a demonstration . . . you'll see how fast to install and how safe new XL BUStribution Duct really is.

BullDog Electric Products Division, I-T-E Circuit Breaker Company, Box 177, Detroit 32, Michigan. In Canada: 80 Clayson Rd., Toronto 15, Ont. Export Division: 13 East 40th St., New York 16, N. Y.



SINGLE INTEGRAL BOLT puts a ton of pressure on keyed bus ends. Joints lock tight *fast*, stay locked.



TEN-FOOT SPANS take fewer hangers and less time to install than ordinary duct.

BULLDOG ELECTRIC PRODUCTS DIVISION
I-T-E CIRCUIT BREAKER COMPANY

KEEP PACE ELECTRICALLY

The d-c breaker you can buy today that won't be obsolete tomorrow

Actually this new-design model FB circuit breaker from I-T-E is somewhat of a phenomenon in its field. Of all breakers available for direct current, this is the only one that really makes use of today's modern materials and up-to-date knowledge of circuit breaker design. You might say it's the only modern d-c circuit breaker on the market today.

HIGH SPEED

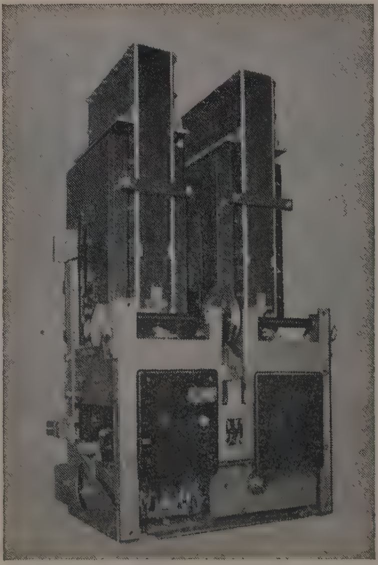
In today's high-capacity d-c circuits, you *need* a high-speed breaker. Otherwise you risk thermal or mechanical damage to equipment—such troubles as commutator flashover in rotating equipment or arc-back damage to your rectifiers. Many circuits today still have semi-high-speed breakers that don't give adequate protection. At the time they were installed they may have been the best available. Or else high-speed breakers were too expensive. That isn't true with the FB. Without paying a premium price, you get high-speed operation. Current limiting action occurs *within 6 milliseconds*. And the breaker may be safely applied to 1000 volt d-c circuits having a rate of rise of 15 million amperes per second. So the FB breaker can be used with confidence in practically all d-c circuits.

COMPACT SIZE AND LIGHT WEIGHT

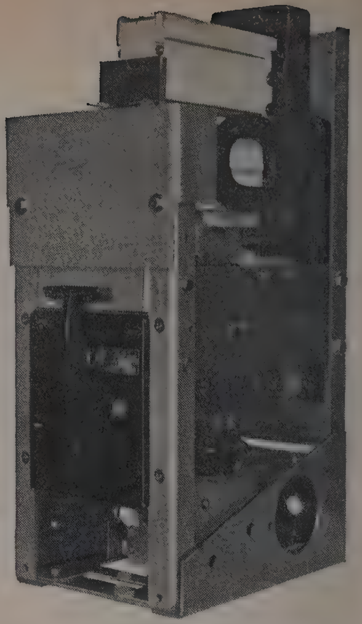
Probably the most obvious difference between the new FB breaker and some of the old-design models still being sold is the greater compactness. This is one of the direct results of modern materials and technology. I-T-E engineers have given you actually superior circuit protection in less space. And the use of modern materials has shaved off many pounds of weight. Because of this they are now available in general-purpose enclosures. In addition, such new-design details as tilting arc chutes, elimination of flexible connectors, and exclusive drawout construction make this the easiest-to-maintain d-c circuit breaker you ever saw.

AVAILABLE IN 1 OR 2 POLES

If you are operating a single-wire grounded system, a single-pole circuit breaker arrangement will suffice. But suppose you are operating a 2-wire, ungrounded system. Then a 2-pole circuit breaker is desirable. And only the I-T-E model FB offers it. This is real 2-pole construction, with both poles fully integrated mechanically and electrically for simultaneous opening and closing under all conditions.



Drawout type 2-pole breaker in 6000 amp rating, electrically operated.



Stationary type single-pole FB breaker in 1200 amp rating with manual stored energy closing.

REALLY FUNCTIONAL MECHANICAL ADVANCES

Who but I-T-E would be first to give you an advance such as manual stored energy closing in a d-c circuit breaker? No slow burning of contacts with the FB. It closes in roughly 1/12 to 1/6 second for greater safety and longer contact life. You have your choice of either manual or electrical closing. The motor-operated closing mechanism draws only 5 amperes—a great advantage over the usual 50 amperes required by solenoids. Precision construction typical of I-T-E equipment, coupled with drawout design, permits complete interchangeability of breakers and parts in breakers of equal rating.

REPLACE NOW

There's questionable economy in trying to stretch out the life of old equipment that can mean costly downtime and inadequate protection. The wiser move is to replace now with new-design model FB breakers that are far ahead of the field. Models in capacities from 1200 through 12,000 amperes continuous and 1000 volts d-c. Write for the new detailed and illustrated Bulletin 4601-1A. I-T-E Circuit Breaker Company, Dept. SW, 1900 Hamilton St., Philadelphia 30, Pa.

I-T-E | **I-T-E CIRCUIT BREAKER COMPANY**

59TH YEAR • SEPTEMBER, 1960

ELECTRICAL
CONSTRUCTION
AND MAINTENANCE

Low-Voltage for Pools

One of the most spectacular sales phenomena of current times is the booming business in home swimming pools. From king-size bathtubs to pools of olympic dimensions, they come in all sizes and shapes, of prefab or custom construction. And, naturally, some have the ultimate charm of attractive underwater lighting.

Unfortunately, there is also a growing number of reports of fatal accidents associated with electric shock in lighted swimming pools. In the common wet-niche installation, the 120-volt lighting fixture and a part of its connecting cord are immersed in the pool. Precision manufacturing and expert installation provide, initially, a reasonably safe system. But, in the typical home pool, expert maintenance is unlikely. Carelessness and even abuse are almost inevitable. Yet, continued safety depends critically upon reliable grounding, correct circuiting, complete insulation integrity and thoroughly watertight assembly under exceptionally adverse environmental conditions.

The electrical industry should take a realistic position on this problem before it gets out of hand. Line voltage underwater lighting is convenient but potentially dangerous if safety provisions are impaired or defeated. An obvious alternative is the use of a low-voltage supply system inherently incapable of delivering a disabling shock under the worst possible conditions of a direct line-to-ground contact hazard underwater.

A low-voltage supply system can be made inherently safe by a wide margin. Present 120-volt lighting equipments can be easily modified for low-voltage lamps. Larger circuit conductors would be required, but large line losses can be tolerated as they are readily compensated for by transformer taps.

Speedy industry action is essential. A new and inherently safe system must be developed and put to wide use quickly before public authorities act to forbid underwater pool lighting entirely—a prospect which is by no means remote in some areas today.

Code authorities have an urgent job. The code is now silent on swimming pool lighting. A crash program for industry guidance is needed. It may be necessary to severely limit line voltage installation to projects where professionally competent maintenance and regular reinspection can be guaranteed. Specific rules for low-voltage installations are also needed to insure that conditions will remain inherently safe without expert care.

Swimming pool shock hazards are sure to be widely discussed at the forthcoming IAEI Section meetings. It is to be hoped that prompt action will follow at the code-making levels. Stricter rules and enforcement procedure may be feasible for commercial and institutional installations, but the maintenance of home pool installations is impossible to control. The safest course is to keep line voltages well away from the pool area.

Wm. T. Stuart

Get starter modifications . . . fast . . . from your General Electric distributor

When a last minute change in application requirements necessitates immediate modification of a magnetic starter, call your General Electric apparatus distributor. He can provide the proper modification kit right off the shelf. Even when your starter is installed, it can be modified on the job in minutes.

Your General Electric distributor stocks industry's most complete line of modification kits. This means he can supply nearly any starter you need—when you need it.

Modifications are easy to make. All necessary parts are included in each kit, and a screwdriver is the only tool needed.

Kits for magnetic starters are available for mounting push buttons, selector switches, or indicating lights in starter enclosures; for adding auxiliary contacts and third overload relays; for changing coils and fuse clips.

For more information, contact your General Electric apparatus distributor or sales office. Or request publication GEA-7020 from General Electric Company, Section 812-03, Schenectady 5, N. Y.

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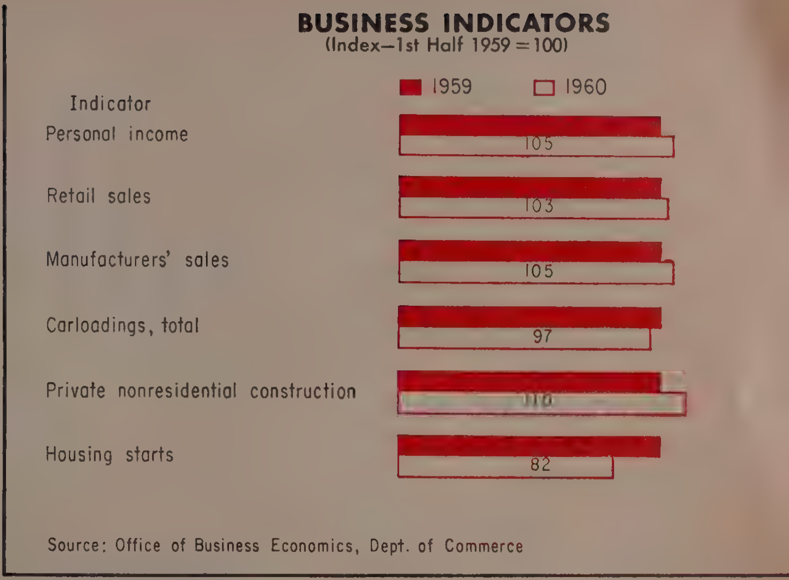
ELECTRICAL
CONSTRUCTION
AND MAINTENANCE



Source: Office of Business Economics, Dept. of Commerce

TRENDS POINT TO

Continuing Electrical Progress

THROUGH 1961

A growing national economy, prospect of a record year in building construction, and continuing progress in electrical equipment designs, standards, and technology all point to continued electrical growth and progress in the year ahead.

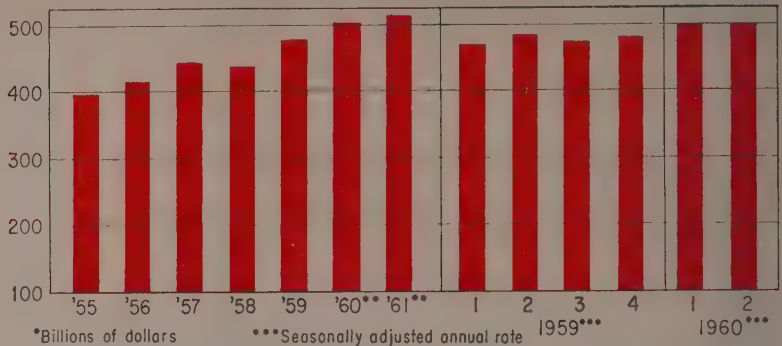
By Berlon C. Cooper

THE NATIONAL ECONOMY

THE national economy in the third quarter of 1960 has slowed to something less than a normal growth rate. It is, however, at the highest level in history, and is continuing to inch upward, even though at a generally disappointing rate.

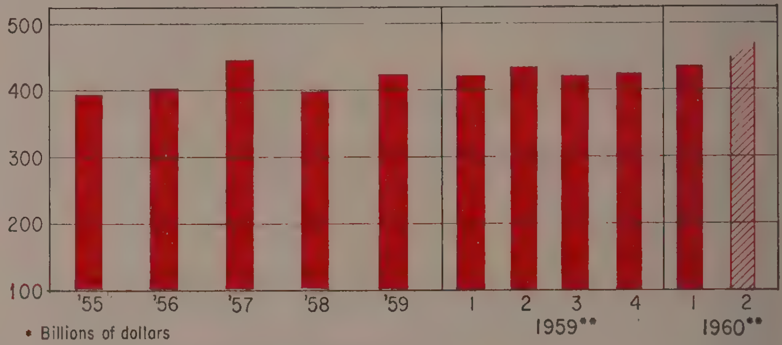
At the end of 1959 most economists expected the economy to set new growth records during 1960, especially in production, personal income, retail sales, housing, employment, and some other fields, including gross national product. Such growth was expected to last through most of 1960, at least, as

GROSS NATIONAL PRODUCT
(In Current Dollars)*



*Billions of dollars
**EC&M estimate, mid-1960
***Seasonally adjusted annual rate
Source: Federal Reserve Board

GROSS NATIONAL PRODUCT
(In Constant (1954) Dollars) *



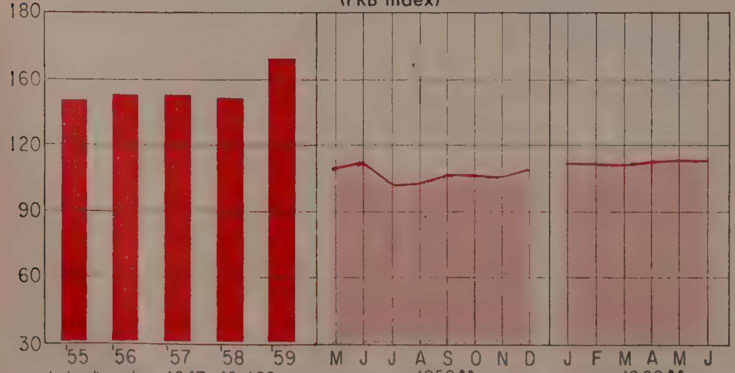
* Billions of dollars
** Constant (1954) dollars, seasonally adjusted annual rate

Economic growth, as measured by the total output of goods and services, or gross national product (GNP), has been relatively steady over the past six years. Measured in current dollars, the increase from 1955 through 1961 is 27.6%, or an average of about 4% per year. Measured in constant (1954) dollars, the increase is 12.6%, or about 2.0% per year. GNP for 1961, as a minimum, is expected to total $517 billion, may go as high as $525 billion.

a result of the slowdown during the last half of 1959, which was brought about by the extended steel strike. Such growth was needed, it was agreed, to replenish inventories, to meet new housing demands, to fulfill demand for new compact autos, and both durable and nondurable goods.

Gross national product has reached new highs, and during the third quarter of 1960 is at an annual rate of about $510 billion. This, however, is some $5 to $7 billion less than had been generally predicted. Industrial output has held within about a 1% range since the beginning of the year, but steel production slid from about 95% of capacity in January to just slightly above 50% of capacity during the summer months. Steel consumption has been at 70% or more of steel production capacity, which means that inventory stockpiles are being gradually used up. Auto manufacturers are now switching

INDUSTRIAL PRODUCTION
(FRB Index) *



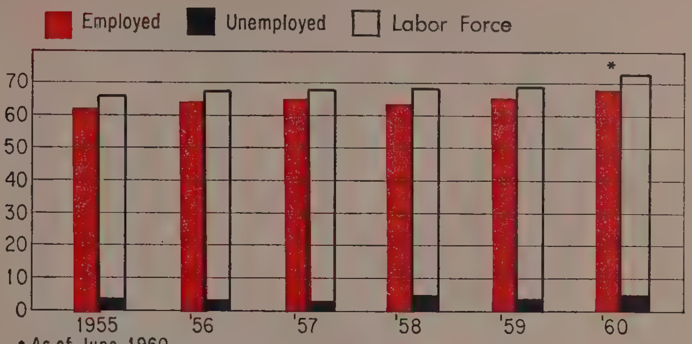
* Index based on 1947-49=100.
** Revised series, unadjusted 1957=100, including utilities.
Source: Federal Reserve Board and Survey of Current Business, Dept. of Commerce.

The FRB index of production has remained stable since January of this year, with a continuing decline in steel production offsetting improvements in other economic sectors. With steel inventories now nearly depleted, with expansion in production of both durable and nondurable goods taking place, and with government spending now being speeded up, an upturn in industrial production seems assured.

Employment reached an all-time record in June. This was expected, of course, as a large group of school students came into the civilian labor force, and set a new record of 73 million. But unemployment was also up, and the workweek in manufacturing this year has declined to 39.5 hours, compared with 40.5 last December, and 40.3 in April a year ago.

EMPLOYMENT AND UNEMPLOYMENT

(Thousands of Persons)



• As of June, 1960
Source: Bureau of Labor Statistics.

PERSONAL INCOME, TAXES, DISPOSABLE PERSONAL INCOME

(Billions of Current Dollars)

Personal income rose 22.5% between 1955 and 1959, for an average of 4% per year. During this same 5-year period, Federal tax on personal income rose 24.4%, and state tax rose 50%. This resulted in an increase of 21.9% in disposable personal income, from $274.4 billion in 1955 to $334.6 billion last year. Disposable income in the second quarter of this year was a seasonally adjusted $354.3 billion.

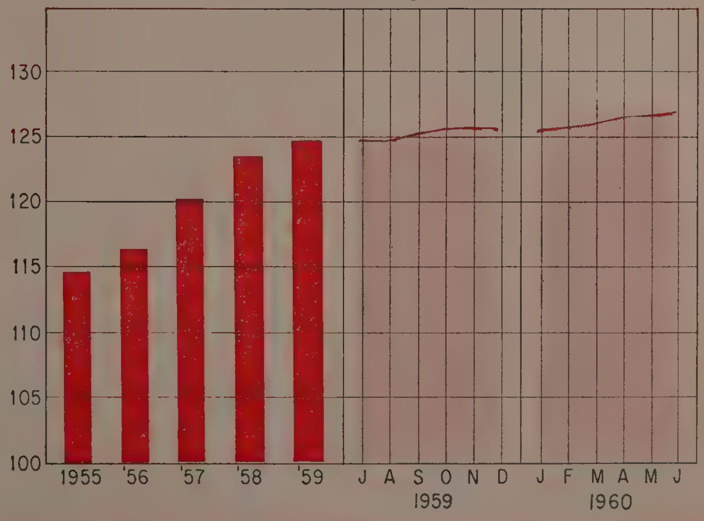
Year	Personal Income	Taxes		Disposable Personal Income
		Federal	State	
1955	310.2	31.5	4.2	274.4
1956	332.9	35.2	4.8	292.9
1957	350.6	37.4	5.4	307.9
1958	359.0	36.7	5.8	316.5
1959	380.2	39.2	6.3	334.6
Quarterly*				
1959—1st	371.8	38.2	6.2	327.4
2nd	381.1	39.5	6.3	335.3
3rd	381.0	39.5	6.4	335.1
4th	386.8	39.7	6.4	340.8
1960—1st	393.1	41.0	6.7	345.4
2nd				354.3

*Seasonally adjusted annual rates, by quarters.

Cost-of-living rose a total of 12 index points only from 1955 to June of this year, with the index based on 1947-49 average as 100. Medical care, one of the many items comprising the Consumer Price Index, showed the greatest growth, or 156.1% of the 1947-49 average.

CONSUMER PRICE INDEX

(Cost-of-Living)



CONSUMER SPENDING

(Billions of Dollars)

Year	Durable Goods	Nondurable Goods	Services	Personal Consumption Expenditures
1955	39.6	124.7	92.6	256.9
1956	38.6	131.4	99.9	269.9
1957	40.4	137.7	107.1	285.2
1958	37.3	142.0	114.2	293.5
1959	43.4	147.6	122.8	313.8
Quarter				
1959—1st	41.6*	145.3*	119.2*	306.1*
2nd	44.4*	147.7*	121.4*	313.6*
3rd	44.0*	148.0*	124.1*	316.0*
4th	43.5*	149.6*	126.6*	319.6*
1960—1st	43.7*	151.1*	126.3*	321.1*
2nd				328.5*

*Seasonally adjusted annual rates by quarters.
Source: Office of Business Economics, Dept. of Commerce.

CONSUMER CREDIT

(Millions of Dollars)

Year	Installment Credit	Noninstallment Credit	Total Consumer Credit
1955	28,958	9,924	38,882
1956	31,897	10,614	42,511
1957	34,183	11,103	45,286
1958	34,080	11,506	45,586
1959	39,482	12,564	52,046
End of Quarter			
1959—March	34,234	10,691	44,925
June	36,135	11,387	47,522
Sept.	37,962	11,388	49,350
Dec.	39,482	12,564	52,046
1960—March	39,648	11,514	51,162

Source: Federal Reserve Board.

RELATION OF CONSUMER CREDIT TO CONSUMER SPENDING

Year	Consumer Credit*	Consumer Spending	Ratio—%
1955	38.9	256.9	15.1
1956	42.5	269.9	15.8
1957	45.3	285.2	15.9
1958	45.6	293.5	15.5
1959	52.0	313.8	16.6
1960**	51.2	321.1	16.0

*Total installment and noninstallment credit, all types.
**Total at end of March, 1960.

Consumer spending during the second quarter of this year was at a rate of $328.5 billion, or 27.9% greater than in 1955. About 13.5% of this was for durable goods, 47% for nondurable goods, and 39.5% for services. The rise in the cost of services has been at a much faster rate than for durable or nondurable goods, due in large part to the rapid increase in direct labor costs. Consumers have been buying more on credit, but the ratio of credit to spending has remained relatively stable.

over to new models, and will soon be producing at near capacity.

Personal income, retail sales and consumer spending have remained at record levels. Now, in this presidential election year, both political parties are committed to increases in government spending at the national level, while state and local government spending continues to increase rapidly, as it has over the past few years. Building construction, which has been running at slightly more than 10% of the economy for the last eight to ten years, is expected to hold its present rate during the balance of this year, and to turn upward slightly again in 1961. A stabilization, and possibly an uptrend, in the national economy therefore seems assured.

The nation's total volume of business is comprised of the volume of consumer spending, the volume of business (capital) expenditures, the volume of government spending, and the net balance of exports above imports. All of these factors are expanding, or at least holding at a record high.

Capital spending in 1960 is expected to total 13.2% more than in 1959, based on recent estimates.

Government spending — federal, state, local—continues its mounting burden on the taxpayers. Thirty years ago government spending was 10.8% of GNP; 20 years ago it was 20.8% of GNP; last year (1959) it was 27.5%, or over one-fourth of our total economic activity. The nation seems headed for a government spending colossus of about 40% of GNP by 1970, if the past trends are not halted.

THE ELECTRICAL INDUSTRY

THE nation's economic health and growth patterns affect the health and growth of the electrical industry, as it does all industries, both directly and indirectly. As pointed out on the preceding pages, the national economy will most likely experience slower growth over the next several months, probably through 1961. But it will also reflect greater stability for the same reason. Thus, it is logical to conclude that growth in the electrical industry will be slower than the normal growth rate, but this growth will occur with stability.

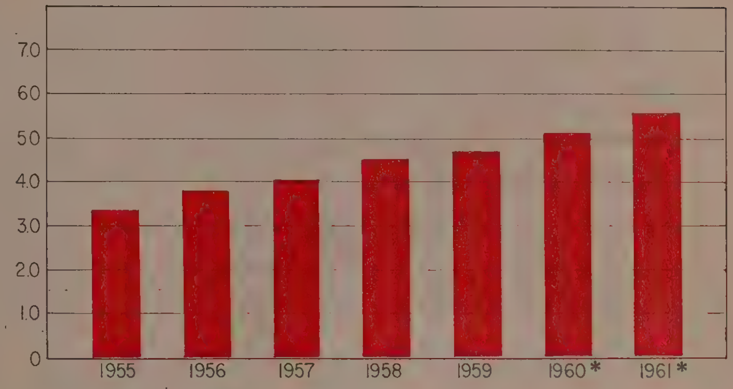
The optimistic outlook of eight months ago for the electrical industry during 1960 has changed, and many of the predictions have not materialized. New construction activity, over-all has actually declined slightly, and homebuilding fell short of earlier predictions. In the economy as a whole, the final demand for goods and services—food, cars, appliances, homes, capital goods, even defense spending—was not as great as was predicted last January. The small boom that was forecast did not occur. Instead, the economy has moved along on a high plateau, showing slight growth over-all, but with some industries—such as steel, autos, housing—experiencing declines.

What has happened in the national economy has contributed to its current strength and stability. Demand for goods and services has expanded, though slowly, and has helped to smooth out production following the steel strike, so that currently production is more sensitive to demand than would have been the case if we had experienced the excesses of a boom. Thus, the likelihood of continued prosperity through 1961 has been greatly enhanced.

Presented in this report are a number of charts and tables covering both national economy factors, and electrical industry statistics and market data. All tables and data are designed to provide up-to-date information for short-range planning, or for planning through 1961. Thus the actual data are shown on an annual basis for each year from 1955 through 1959, and estimated for 1960. In some tables, forecasts are also projected for the year 1961. Data for 1959, and for 1960 to the extent that it was available, have also been shown on either a quarterly, or monthly, basis. Thus, it should be easy for readers to estimate trends through the next 16 months, as specifically needed for individual requirements.

ELECTRICAL WORK IN CONSTRUCTION

(Billions of Dollars)



*Estimate, as of mid-1960

1960 ELECTRICAL CONSTRUCTION

(Millions of dollars)

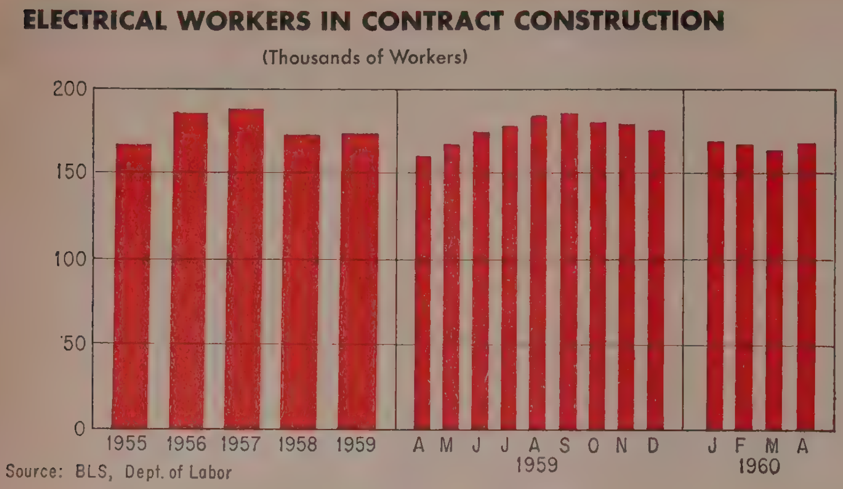
Type of Construction	Volume*
Private Funds	
Residential	860
Industrial	460
Commercial and Institutional	1,019
Utilities	396
Farms	89
Other	8
Total Private	**2,832**
Public Funds	
Residential	32
Industrial	67
Educational	385
Institutional	201
Military	41
Highway and Conservation	318
Other	18
Total Public	**1,062**
Total for New Construction	3,894
Total for Modernization and Repair	1,200
Total Electrical Construction Work	5,094

* EC&M estimate as of mid-1960.

Electrical Construction

The growth of electrical work in new construction and modernization from 1955 to 1958 was roughly 10% per year. This growth rate dropped to 5.2% in 1959, and is estimated to average about 7.7% this year over 1959. A growth rate of 8% is

ELECTRICAL WORKERS IN CONTRACT CONSTRUCTION



Source: BLS, Dept. of Labor

Estimated average hourly union wage scale for electricians as of April 1, 1960, was $3.90, up 4.6% from April 1959, and ranged from $2.63 to $4.60 across the country. Average hourly earnings have increased 29.2% from 1955 to April of this year, or an average of about 5.25% per year.

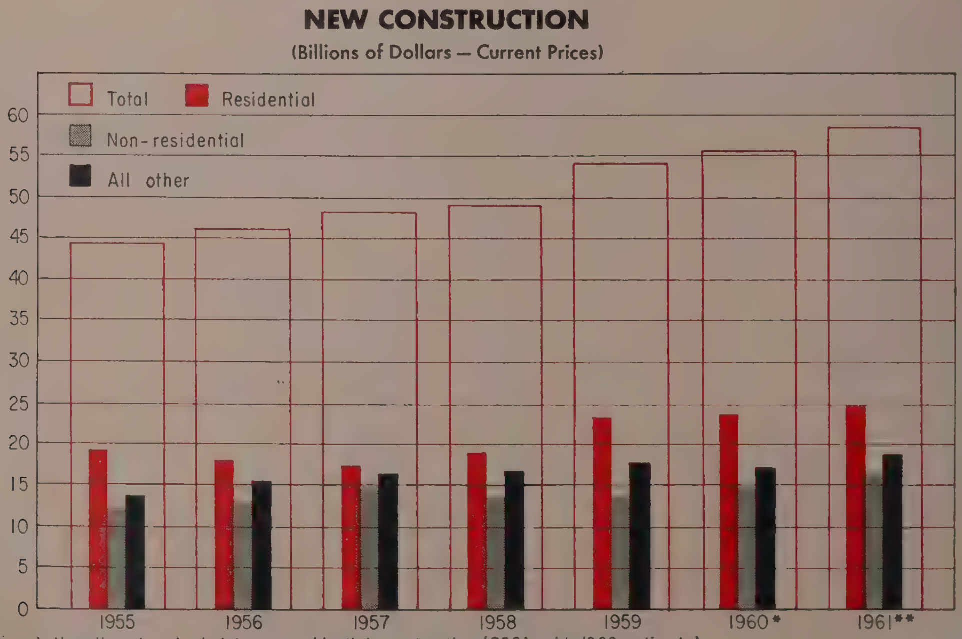
predicted for 1961 (see actual dollar volume in chart on "Electrical Work in Construction").

Part of the reason for the change in the rate of growth is due to the change in the "mix" of the type of electrical construction work involved. For example, electrical work in residential construction in 1960 (see table, "1960 Electrical Construction") totals $892 million, out of the total of $3,894 million for total new construction. This is 23% of the dollar volume of new electrical construction work, but residential construction dollar volume (see table, "New Construction") is 42.3% of the total new construction dollar volume. In other words, the percentage of the construction dollar in residential construction that goes into electrical construction work is relatively low.

In the classification of "nonresidential new construction," which carries an estimate of $14,625 million for 1960, or 23.5% of total new construction, electrical work is estimated at $2,132 million, which is 54.7% of the total electrical construction dollar volume of $3,894 million for new construction. Thus, sizable variations in the "mix" of new construction, between "residential" and "nonresidential," can result in even greater variations in the annual dollar volume of electrical construction work.

The number of electrical workers in contract construction in 1959 averaged 174,000, according to the Bureau of Labor Statistics. The

NEW CONSTRUCTION



*Includes Alaska and Hawaii, and revised data on residential construction (BDSA mid-1960 estimate)
**EC&M estimate, as of mid-1960.   Source: Depts. of Commerce and Labor

total dollar volume of electrical construction work in new construction in 1959 was $3,497 million, or roughly $20,000 of work per electrical worker. Since the average annual earning per electrical employee (see "Electrical Workers' Hours and Earnings") was approximately $7,428, 37.2% of the gross dollar volume of work per employee went for wages. The remaining $12,572 gross volume per employee went for material, overhead and profit.

Electrical workers' hours worked per week, on an annual average basis, peaked in 1956 at 39.5 hours. The average for last year, 1959, was 38.4 hours. In March of this year, the average weekly hours worked was 38.0, due in part to severe weather, and possibly in part

ELECTRICAL WORKERS' HOURS AND EARNINGS

Year	Average Weekly Hours	Average Weekly Earnings	Average Hourly Earnings
1955	39.1	$116.52	$2.98
1956	39.5	125.22	3.17
1957	39.2	132.10	3.37
1958	38.3	135.97	3.55
1959	38.4	142.08	3.70
Month			
1959—March	38.3	138.65	3.62
June	39.0	143.91	3.69
Sept	37.0	138.75	3.75
Dec	39.1	148.19	3.79
1960—March	38.0	146.30	3.85

Source: BLS, Dept. of Labor.

NEW CONSTRUCTION OUTLOOK FOR 1960

(Millions of Dollars)

TYPE OF CONSTRUCTION	Dollar Value Actual 1959	Dollar Value Estimate* 1960	% Change 1959/1960
TOTAL NEW CONSTRUCTION	**$56,033**	**$55,825**	**
PRIVATE CONSTRUCTION	**39,848**	**39,825**	**
Residential buildings (nonfarm)	24,469	22,925	−6
New dwellings units	19,233	17,400	−10
Additions and alterations	4,468	4,600	+3
Nonhousekeeping	768	925	+20
Nonresidential buildings (nonfarm)	8,859	10,075	+14
Industrial	2,106	2,700	+28
Commercial	3,930	4,200	+7
Office buildings and warehouses	1,954	2,100	+7
Stores, restaurants and garages	1,976	2,100	+6
Other nonresidential buildings	2,823	3,175	+12
Religious	947	1,025	+8
Educational	525	575	+10
Hospital and institutional	570	575	+1
Social and recreational	550	700	+27
Miscellaneous	231	300	+30
Farm construction	1,261	1,150	−9
Public utilities	5,052	5,375	+6
Railroad	251	300	+20
Telephone and telegraph	952	1,125	+18
Electric light and power	2,072	1,925	−7
Gas	1,657	1,925	+16
Other public utilities	120	100	−17
All other private	207	300	+45
PUBLIC CONSTRUCTION	**16,185**	**16,000**	−1
Residential buildings	962	825	−14
Nonresidential buildings	4,502	4,550	+1
Industrial	360	400	+11
Educational	2,656	2,650	**
Hospital and institutional	428	400	−7
Administrative and service	564	575	+2
Other nonresidential buildings	494	525	+6
Military facilities	1,459	1,225	−16
Highways	5,888	5,800	−1
Sewer and water systems	1,467	1,525	+4
Sewer	906	900	−1
Water	561	625	+11
Public service enterprises	551	650	+18
Conservation and development	1,127	1,200	+6
All other public	229	225	−2

* Mid-year 1960 estimate.
** Change of less than ½ percent.
Source: Construction Industry Division, BDSA, Dept. of Commerce.

BACKLOG OF PROPOSED ENGINEERING CONSTRUCTION

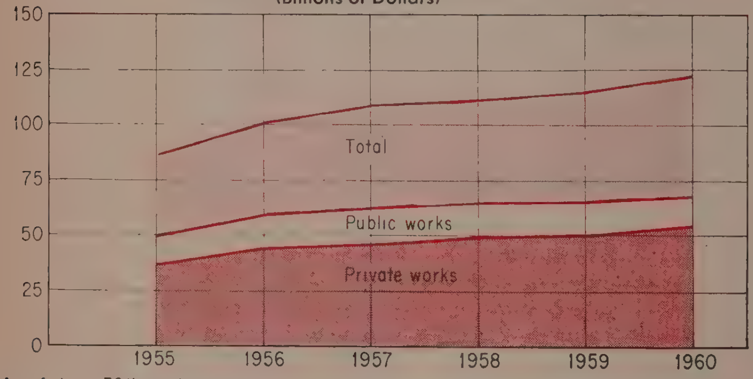
(Thousands of Dollars)

Type of Construction	Backlog*	% of Total
Private Projects		
Bridges	98,436	0.1
Industrial buildings	17,713,304	14.4
Commercial buildings	26,620,720	21.7
Unclassified	10,548,533	8.6
Total Private Projects	54,980,993	44.8
Public Works Projects		
Waterworks	2,891,184	2.4
Sewerage	3,891,788	3.2
Bridges	3,345,123	2.7
Earthwork, irrigation, drainage	11,853,664	9.7
Streets and roads	13,720,450	11.2
Buildings	22,141,981	18.0
Unclassed	9,852,701	8.0
***Total Public Works Projects**	**67,696,891**	**55.2**
Total Backlog (Private and Public)	**122,677,884**	**100.0**
Federal Government work, included in Public Works Projects	**14,060,130**	**11.5**

* For United States, including Alaska and Hawaii, as of June 30, 1960.
Source: Engineering News-Record.

GROWTH OF PROPOSED ENGINEERING CONSTRUCTION BACKLOG*

(Billions of Dollars)



*As of June 30th each year
Source: Engineering News-Record

The backlog of proposed engineering construction has increased 44% since mid-1955. During this same period, total new construction has climbed from $44.6 billion in 1955, to an annual rate of $55.8 billion in June of this year, or 25%. The backlog is climbing faster than actual work is being done.

due to a slight slowdown in construction.

Wages for electrical workers, on both an hourly and a weekly basis, have climbed consistently since 1955, and are currently at an all-time high (see table "Electrical Workers' Hours and Earnings").

Building Construction

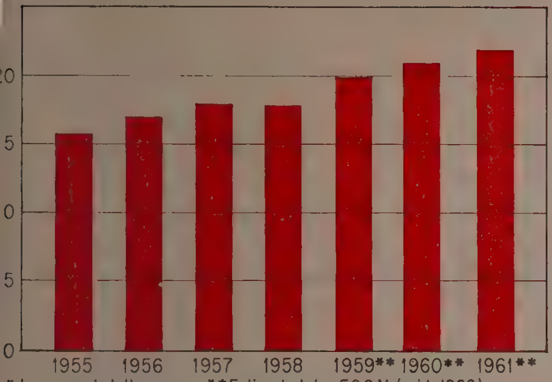
New construction dollar volume has declined slightly during the earlier months of this year, on a year-to-year basis. However, at mid-year, Dept. of Commerce forecast that for 1960 as a whole, expenditures should total about $55.8 billion, or nearly the same as in record-breaking 1959. The forecast indicates that despite a weakness in private housing, outlays for private construction should total $39.8 billion, maintaining the 1959 level, which was 14% above 1958. Public construction expenditures rose only 4% in 1959, and will not show a significant change between 1959 and this year.

Over the past ten years, new construction dollar volume has averaged in excess of 10% of the total economy (10% of GNP, in current prices). Actually, in 1955 new construction was 11.2% of GNP, and in 1959 it was 11.3%. In 1960 it will probably run about 11%, overall, down slightly due to the slowing down of construction this year.

Over the decade of the Sixties, it is still the opinion of most new construction analysts that construction activity will continue its upward trend. A year ago *Electrical Construction and Maintenance* forecast a $72 billion new construction volume by 1970. (EC&M, Sept., 1959, page 78). The backlog of proposed engineering construction, as of June 30, 1960, stood at a new high of $122.7 billion, as reported by *Engineering News-Record*, a McGraw-Hill publication. This is up from $114.1 billion a year earlier. Also, the F. W. Dodge Corporation predicted in the August 1960 issue of *Architectural Record*, a 77.6 billion dollar volume of new construction for 1969, measured in constant (1959) dollars, and a total market of $650 billion in new construction goods and services for the decade as a whole.

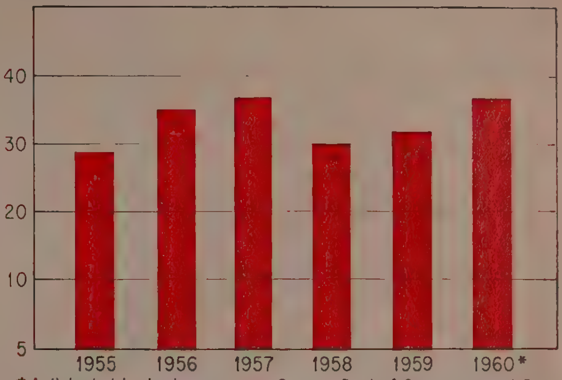
A major factor in the new construction activity will continue to be residential building (new dwellings, additions and alterations, and nonhousekeeping units). In 1960, residential construction is estimated at 42.3% of the total, with a total volume of $23,750 million. Under the Census Bureau's revised (1960) series for annual housing starts, total nonfarm starts in 1959 were 1,550,900. Future housing needs, based on population growth, new household formations, slum clearance, replacement, increased vacancies, etc., may raise the annual needs by the end of the decade to some 1,750,000 or more units, at an annual cost of about $34 billion. These new homes will require a higher

CONSTRUCTION MAINTENANCE AND REPAIR (Billions of Dollars)*



* In current dollars **Estimated by EC&M (mid-1960)
Source: Depts. of Commerce and Labor.

BUSINESS SPENDING ON NEW PLANT AND EQUIPMENT (Billions of Dollars)



* Anticipated by business.
Source: Dept. of Commerce, and Securities and Exchange Commission.

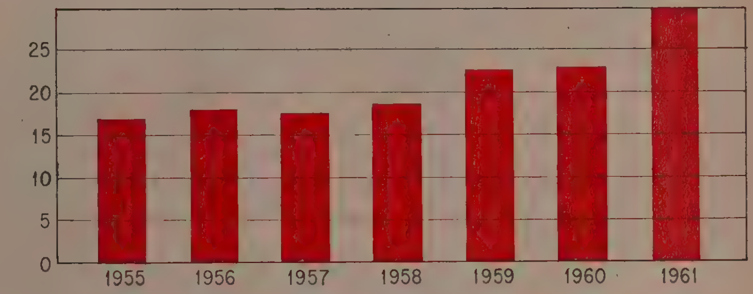
percentage of electrical work as living standards, and greater use of electric power increase.

Industrial construction, which peaked at $3.6 billion in 1957, is expected to total only about $3.1 billion this year—$2.7 billion in private expenditures, and $0.4 billion with public funds. According to a recent study by the McGraw-Hill Department of Economics, industrial construction volume for the next ten years will total about $45 billion, or an average of $4.5 billion annually (in 1960 dollars). The average for the past ten years has been $2.7 billion annually. Thus, industrial construction is expected to be two-thirds greater in the coming decade than in the past ten years. Some of the key forces which will bring about this upsurge in industrial construction include new products, new trends in transportation and in natural resource usage, changes in the labor force and in income levels, a shift in the geographic distribution of new industrial buildings, a greater emphasis on the construction of moderate-size plants, and a greater emphasis on aesthetics in plant design. Inherent in this industrial plant expansion will be an expanding market for electrical construction work. This type of construction already carries a sizable percentage of total construction dollar volume for electrical work, and this percentage may also be expected to increase by from 50% to 75% over the next decade.

Capital spending for new plant and equipment (see chart) picked

RESIDENTIAL CONSTRUCTION DOLLAR VOLUME

(Billions of Dollars)



EC&M estimate, mid-1960

ANNUAL HOUSING STARTS

Year	Former Series Nonfarm Starts	New Series* Nonfarm Starts	Total Starts
1955	1,328,900		
1956	1,118,100		
1957	1,041,900		
1958	1,209,400		
1959	1,378,500	1,530,900	1,553,100
Quarterly			
1959—1st	302,500	326,600	329,800
2nd	415,900	460,600	465,200
3rd	328,400	424,700	432,000
4th	281,700	319,000	326,100
1960—1st	250,600	261,100	267,500

* New statistical series, by Census Bureau, includes Alaska and Hawaii, and farm construction, plus improved data. Old series covered nonfarm starts alone.

Source: Bureau of Labor Statistics, Census Bureau, and Construction Division, Dept. of Commerce.

Number of dwelling units started annually has fluctuated fairly widely over the past five years. Also, the statistics have not been too reliable. The best post-War II housing year was 1950, when 1,396,000 dwelling units were started. The low point since 1950 was 1957, when total starts dropped to 1,041,000 units. Annual dollar volume for residential construction, on the other hand, has been more stable, has actually increased from year-to-year with the exception of 1957.

TWO DECADES OF INDUSTRIAL CONSTRUCTION

(Millions of Dollars)

Year	Private Expenditures	Public Expenditures	Total Volume
1950	1,062	224	1,286
1951	2,117	974	3,091
1952	2,320	1,684	4,004
1953	2,229	1,771	4,000
1954	2,030	1,506	3,536
1955	2,399	721	3,120
1956	3,084	453	3,537
1957	3,162	458	3,620
1958	2,382	408	2,790
1959	2,008	364	2,372
1950–59	22,793	8,563	31,356
1960*	**2,700**	**400**	**3,100**
1960-69**			**45,000**

* BDSA, Dept. of Commerce estimate, mid-1960.
** EC&M estimate, in 1960 dollars, mid-1960.
Source: Dept. of Commerce.

PRIVATE COMMERCIAL CONSTRUCTION

(Millions of Dollars)

Year	Office Buildings and Warehouses	Stores, Restaurants and Garages	Total Volume
1955	1,311	1,907	3,218
1956	1,684	1,947	3,631
1957	1,864	1,706	3,570
1958	2,013	1,576	3,589
1959	1,954	1,976	3,930
1960*	2,100	2,100	4,200

* Mid-1960 estimate, BDSA, Dept. of Commerce.
Source: Dept. of Commerce.

SCHOOL CONSTRUCTION

(Millions of Dollars)*

Year	Private	Public	Total
1946	123	101	324
1947	174	287	461
1948	253	618	871
1949	269	934	1,203
1950	294	1,133	1,427
1951	345	1,513	1,858
1952	351	1,619	1,970
1953	426	1,714	2,140
1954	529	2,134	2,663
1955	492	2,442	2,934
1956	536	2,549	3,085
1957	519	2,832	3,351
1958	574	2,875	3,449
1959	532	2,637	3,169
1960**	575	2,650	3,225

* Current Dollars.
** Mid-1960 estimate, by BDSA, Dept. of Commerce.
Source: Dept. of Commerce.

Three major sources for electrical work are industrial, commercial and school building construction. A volume of about $10.8 billion of construction in these three fields only is estimated for 1961, which should account for something in excess of one billion dollars of electrical work. During the coming decade, it is further estimated that industrial construction will increase at least 50% over the total for the past decade, to a total of about $45 billion.

up about 6.6% in 1959 over its low point of $30.5 billion in 1958, and in 1960 is expected to increase about 14% above the 1959 volume. A really strong factor in this growth, which may be expected to keep it growing, is technology—new knowledge, new techniques, new skills, new organizational schemes — backed up by expanding research and development, and new products of all types.

Another strong market for electrical construction work is private commercial construction, such as office buildings, warehouses, stores, restaurants, and garages. The growth of building construction in this area is shown in the table "Private Commercial Construction."

Private and public school construction spending has more than doubled during the last decade, and this has occurred without benefit of Federal financial aid. This market should continue its expansion during the next few years, at a growth rate equal to its growth rate over the past decade, either with or without Federal aid which is currently under discussion by Congress. Such expansion is more than ample to take care of the school construction needs for this period.

Electric Power Industry

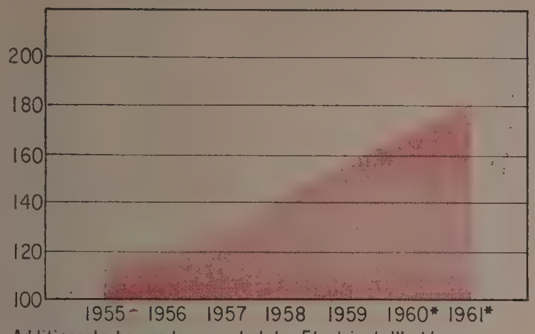
Electric power generating capability continues to expand. The electric utilities companies are currently adding about 12 million kw capacity to their lines annually. This is more than adequate to meet the existing growth demands of electric power production, expanding at an annual rate of about 8 to 9%, or about 55 billion kwhr per year in 1960.

The record of the sale of electric power, from 1955 to 1959, in dollars, in kwhr, and in number of customers, is shown in the table "Electric Energy Sales in U. S." Over this five-year period, dollar volume is up 31.8%; kwhr sales are up 30.3%; and number of customers is up 9.4%.

Revenues from residential electric service this year will total about $4.7 billion for 188.2 billion kwhr. Growth rates in the residential field are high, and are expected to expand still further under the impact of the Medallion Home industry promotion. This expansion will re-

ELECTRIC POWER GENERATING CAPACITY

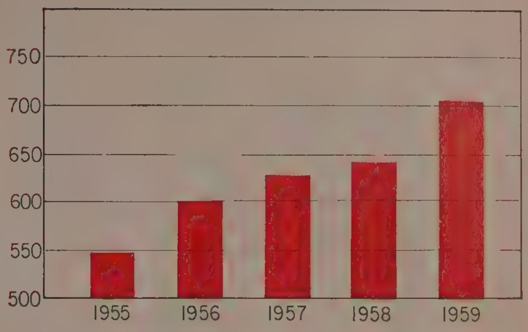
(In millions of kilowatts)



*Additions to be made, reported to Electrical World
Source: Federal Power Commission

ELECTRIC POWER PRODUCTION

(Billions of kwhr generated in U.S.)



Source: Electrical World

Production and distribution of electric power by the electric utilities companies are more than doubling each decade. This is a good barometer for electrical industry generally. **Electrical World** has forecast that by 1975, generating capability will reach 479 million kw, and energy sales will climb to about 2.1 trillion kwhr.

ELECTRIC ENERGY SALES IN U. S.

Year	Total Sales (Thousands of Dollars)	Total Sales (Millions of kwhr)	Total Ultimate Customers
1955..........	$8,020,439	480,921	52,558,601
1956..........	8,698,808	530,128	53,994,893
1957..........	9,289,602	557,829	55,171,089
1958..........	9,733,806	569,161	56,208,491
1959..........	10,572,652	626,743	57,504,761

Source: Edison Electric Institute.

USE AND COST OF ELECTRICAL ENERGY FOR RESIDENTIAL CUSTOMERS

Year	Annual Kwhr*	Total Annual Cost*	Annual Cost/kwhr*
1955............	2,751	$72.63	2.64¢
1956............	2,969	77.19	2.60
1957............	3,174	81.25	2.56
1958............	3,366	85.16	2.53
1959............	3,585	89.63	2.50

* Averages.
Source: Edison Electric Institute.

flect in still more electrical construction work.

The Lighting Industry

An estimate of the dollar volume of lighting equipment being sold this year is given in the table on "1960 Lighting Equipment Dollar Volume." This table gives the estimated value of lighting equipment sold for each of the types of construction as listed and reported on monthly by the U. S. Census Bureau, Dept. of Commerce.

Previous forecasts on lighting equipment dollar-volume growth have indicated that the lighting industry more than doubles every ten years. These forecasts have shown actual dollar volume in 1950 at $289.7 million, in 1955 at $423.6 million, and the estimated volume for 1960, shown in this report, at $638.4 million. Previous forecasts for the future include 1965 at $1.0 billion, and 1970 at $1.4 billion. These forecasts are still valid.

Also shown in this report are the approximate sizes of a number of specialty lighting industries, based on their annual dollar volumes in 1959. These data have been obtained through independent market research studies on a one-time basis, and are presented here on that basis. The floodlighting data do not include residential, shopping center, or gasoline station lighting. The theatrical and movie lighting is based upon new school construction. And the swimming-pool lighting is based on the use of 142,000 units in 1959, and the statistic that 92% of all pools have some underwater lighting.

Research and development work in the electrical industry is at an all-time high, and growing. This work is in many fields, is expanding into still others, and is being carried out by both electrical and non-electrical manufacturing firms. Included in this research are such items as have been announced in recent months, as listed below.

1. *Power generators*—new types of power sources are under study and refinement, spurred on by the need for power for space vehicles. Five recent devices are: *solar cell,* which uses a semiconductor material to convert light into electricity; *thermoelectric couple,* which converts heat into electricity by means of two different types of semiconductors; *fuel cell,* which converts chemical energy into electricity; *thermionic tube,* which harnesses atomic energy, focused sunlight, or the hottest radioactive isotopes; and *magnetohydrodynamic gener-*

1960 LIGHTING EQUIPMENT DOLLAR VOLUME

(Used for General Lighting Purposes)*
(Thousands of Dollars)

Type of Construction Where Used	Value**
Total New Construction	**$566,307**
Private Construction	**415,292**
Residential (nonfarm)	111,040
Nonresidential building	284,524
Industrial	80,703
Offices, warehouses and loft buildings	68,250
Stores, restaurants and garages	75,600
Other nonresidential buildings	59,971
Religious	22,038
Educational	12,075
Hospital and institutional	10,350
Social and recreational	11,008
Miscellaneous	4,500
Farm construction	2,013
Public utilities	17,445
Telephone and telegraph	7,875
Other public utilities	9,570
All other private	270
Public Construction	**151,015**
Residential building	2,888
Nonresidential building	95,256
Industrial	8,160
Educational	59,731
Hospital and institutional	7,200
Administrative and service buildings	12,285
Other nonresidential building	7,880
Military facilities	5,111
Sewer and water systems	2,142
Public service enterprises	2,608
Conservation and development	960
Highways (includes street lighting)	41,600
All other public	450
Modernization	**80,000**
Total Lighting	**638,367**

* Does not include searchlights, automotive, aircraft or railway coach lighting, residential portable lamps, and similar types of lighting equipment not associated with building construction.

** EC&M estimate, mid-1960, based on Dept. of Commerce forecast for 1960 new construction at mid-year.

ator (MHD), which produces electricity by moving a conductor in a magnetic field—in which the "conductor" is a stream of hot (3000°C) gas that has been "seeded" with ions.

2. A remote-controlled electronic guard system, which utilizes all the wizardry of electronics—noise detectors, closed-circuit TV, sound wave generators.

3. Transistors and semiconductors—tiny chips of specially prepared germanium metal which offer new approaches to control and amplification of electrical signals. These devices were discovered more than a decade ago, but are now being adapted widely throughout the electrical industry.

4. New lighting developments: a) integrated lighting-heating-cooling systems; b) outdoor-type fluorescent lamps; c) new pencil-thin incandescent (Quartzline) lamps, with iodine added to the gas inside the bulb to prevent bulb blackening; d) new "peaking-ballast" dimming for fluorescent lamps; e) new transistor-type high-frequency inverters for fluorscent high-cycle lighting; f) more efficient electroluminescent lighting, including new colors; and g) a new "light-amplifier" device which uses a cube of synthetic ruby with peculiar optical properties, which reportedly makes possible the projection of a narrow light beam as intense as the sun.

These are only a few of the developments in the electrical field, which have already been announced and widely publicized. There are undoubtedly many, many more inventions and innovations under intense study and development at this time, some of which will be reported on in the months ahead and in the early 1960s. The impact of such research and development work will undoubtedly be great.

Electric Heating

The total dollar volume for shipments of all types of heating equipment for habitable structures in 1959 was $387 million, according to Building Materials Division, BDSA, Dept. of Commerce. Of this total, $27.8 million, or 7% of the total, was for electric heating equipment (see table, next page). The volume of other types of equipment was: gas—46%; oil—42%; and solid fuel—5%.

The market potential for the use of electricity as the heat-producing medium in all types of space heating equipment has long been recognized. Over the past ten to twelve years, many electric utilities companies and others have conducted studies on various methods of heating using electricity as the source of heat. More recently, the "Live Better Electrically," and the "Medallion Home" programs, which are devoted to the promotion of the all-electric home concept, have been sponsored by most of the electric utilities companies, and by electrical equipment manufacturers. These research and promotional efforts are producing results, as is indicated by these statistics.

Although the principal market for electric heat is in new-home construction, and in the rehabilitation of existing dwellings, it is also adaptable for use in commercial structures. Unit heaters are used

SPECIALTY LIGHTING INDUSTRIES

(Annual Dollar Volume, 1959)

Type of Lighting	Size of Industry ($000)
Industrial Safety	
Explosion Proof Luminaires	$4,000-$5,000
Dust Proof Luminaires	$300
Vapor Tight Luminaires	$5,000
Floodlighting Luminaires	$6,000*
Surgical Luminaries	$8,200
Dental Luminaires	$1,100
Theatrical	
Spot and floodlights	$5,000-$6,000
Movie Set Lighting	$1,000
Swimming Pool	
Underwater lighting	$4,600

*Does not include residence, shopping center, or gasoline service station lighting.
Source: Based on some independent studies.

mainly in commercial and industrial installations. Unit ventilators are primarily used in commercial and school construction.

Not included in the Dept. of Commerce data are heat pumps, which have been used on an increasing basis over the past decade. Some idea of the relationship between number of installations of resistance heating and heat pumps is provided by a survey last year, conducted by *Electrical World*, which indicated the number of installations which would be completed and in use as of December 31, 1959. This survey indicated that there would be a total of 613,250 resistance heating installations—579,000 in homes, and 34,250 in commercial and industrial buildings. It also indicated there would be a total of 78,900 heat pump installations—43,300 in homes and 35,600 in commercial and industrial structures.

The outlook is for continuing growth in the use of electric heating, spurred to new growth rates by lower and more attractive energy costs, technological advances in equipment, stepped-up market and sales promotion by utilities and equipment manufacturers.

The decade of the 1950's just closed, was a period of production growth, and expansion of facilities and capacities, in the electrical field as elsewhere. The decade of the 1960s, now getting under way, presents a challenge for market expansion, or the creation of new and larger markets to consume more of the products that can now be turned out at a faster rate and a lower cost. Over the next decade, the population gain will probably be on the order of 20%, and export markets should increase as living standards throughout the free world are improved. Research and development will account for many new products, and for spectacular improvements in existing products. Automation of production lines will help to reduce costs of these new and improved products. Strong market promotion can help to expand sales of these products. Thus, the outlook for the electrical industry is an optimistic one of continuing electrical progress.

ELECTRIC HEATING EQUIPMENT

(Value* of 1959 Shipments)

Type of Equipment	Output Btu/hr (000)	Total Value* (Dollars)	Percent of Total (Dollar Value)
Baseboard (not including glass panels)	9,571,986	$8,325,587	29.9
Convectors:			
Without fan	1,618,280	5,596,254	20.1
With fan	1,138,839	4,250,219	15.3
Glass panels:			
Baseboard	590,819	660,936	2.4
Radiant	234,101	1,432,897	5.1
Unit heaters and unit ventilators	666,601	5,654,322	20.3
Warm air furnaces:			
Central	54,660	88,828	0.3
Floor	21,807	51,701	0.2
Wall	66,760	210,522	0.8
Cable systems fabricated as:			
Units	589,239	1,095,607	3.9
Cable only	85,520	467,421	1.7
Total	14,638,612	$27,834,294	100.0

* At manufacturers' selling prices.
Source: Building Materials Div., BDSA, Dept. of Commerce.

Let's get realistic about . . .

Voltage Drop in

Design limitation of voltage drop in circuits can add substantially in increased copper, raceway and labor costs of the overall system. For this reason, permissible voltage drops in any system should be realistically related to the voltage characteristics of load devices supplied. Here's a close look at voltage drop in terms of efficiency vs economics for apartment-house wiring.

By **Frederick Latzer,** Consulting Engineer, New York, N. Y.

VOLTAGE drop as an engineering consideration in design of electrical wiring systems has been a subject of much study through the years. An almost endless stream of literature has told how to calculate voltage drop for this, that or the other system of supply—in magnetic or non-magnetic raceways—for different power factors—for circuits of all conceivable lengths. The subject has been treated in charts, tables, slide rules and assorted calculator devices. Short and long do-it-yourself formulas can be found in textbooks and handbooks, prepared by professional associations, by manufacturers and by various individual authorities. But on the subject of *voltage drop in apartment houses*, there is woefully little information available to the electrical construction industry. To stimulate development of such information, this article explores the subject in detail.

Present standards on voltage drop are contained in our codes, and one cannot but wonder why these standards have not been reviewed in the light of modern electrical needs. For instance, the allowable voltage drop in power feeders is generally set at 3%. The National Electrical Code, Sec. 215-3, sets forth 3%, although this is only a recommendation and is not mandatory. And the Chicago electrical code, as another example, says, "Good engineering practice requires that total voltage drop in power circuits to motors be held to a maximum of 5%, with 2% allocated to the branch circuit" (i.e., 3% in the feeder).

The allowable drop in lighting feeders is generally set at 1%. The N. E. Code advises that feeder drop be "not more than 1% for lighting and for combined lighting, heating and power loads." The Chicago code further states, "Because of the more critical situation on lighting and heating circuits, with a 100% steady load, a total of 2% drop is recommended, with 1% allocated to branch circuits" — which leaves 1% drop for the feeder.

Minimum voltage levels throughout electrical systems are of great concern to the system designer. In many cases, voltage tolerances can be most critical. And it is proper and necessary that our codes set the low limits of voltage levels as a precautionary safeguard in a competitive industry. But the problem should be treated realistically—in terms of today's systems, loads and electrical needs.

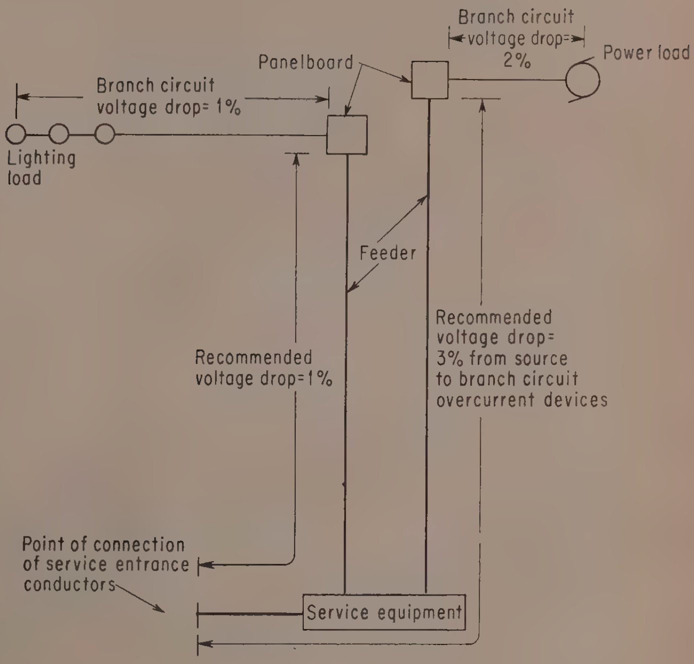
To arrive at some practical figures on optimum voltages we first must establish basic voltage conditions for apartment houses:

Service Voltage—We can safely take this to be nominally 120 volts. Over 80% of the supply systems of the country have apparently standardized on this figure; and for the large apartment house projects we are discussing, the percentage is probably nearer 100%. *Nominal* 120 volts does not of course mean an actual 120 volts at all times. Probably 117 volts at peak loads and 123 volts at minimum loads would be more realistic. Therefore, since voltage drop on feeders should be computed at peak loads, let us take the lower service voltage to be considered in our study as 117 volts. But let us not overlook the higher voltage of 123—this may be more important than the low limit.

Device Voltages—For purposes of this discussion, utilization devices affected by voltage application limits fall into the general categories of: lighting, heating, motor-driven, and electronic. We shall discuss the voltage operating limits of each, in turn. To ascertain what these limits should be, we contacted a number of the leading manufacturers of the last three types, requesting information on the nominal nameplate voltage rating and the lower and upper recommended operating limits. The voltage figures hereinafter used represent the consensus of the information obtained.

Lighting—Incandescent, fluorescent, mercury-vapor and other gas-

Apartment Houses



TRADITIONAL RECOMMENDATIONS ON VOLTAGE DROP

eous-discharge lamps are considered. Of these only the first can be said to be sensitive to voltage variation, since the lumen output drops appreciably with drop in voltage and lamp life is seriously affected by a rise in voltage. On the other hand, fluorescent and mercury lamps are relatively immune to moderate changes in voltage. For instance, on a 120-volt nominal base, fluorescent lamps will satisfactorily operate and ballasts are designed for a 110-125-volt range. Mercury-lamp transformers have taps for 105/118 volts—make your own choice.

Practically then, to arrive at some minimal value of desirable lighting voltage at the using point, we can confine our probing to the incandescent lamp. This is where our modern-condition consideration first materializes—for it must be said that, except in residential use, the filament lamp has definitely been relegated to secondary importance. Let us, therefore, talk about the one place where voltage drop should definitely be limited and where it probably would be greatest — the large apartment house, where the distance between the utility's supply point and the furthest lamp of a tenant can well reach 300-400 ft.

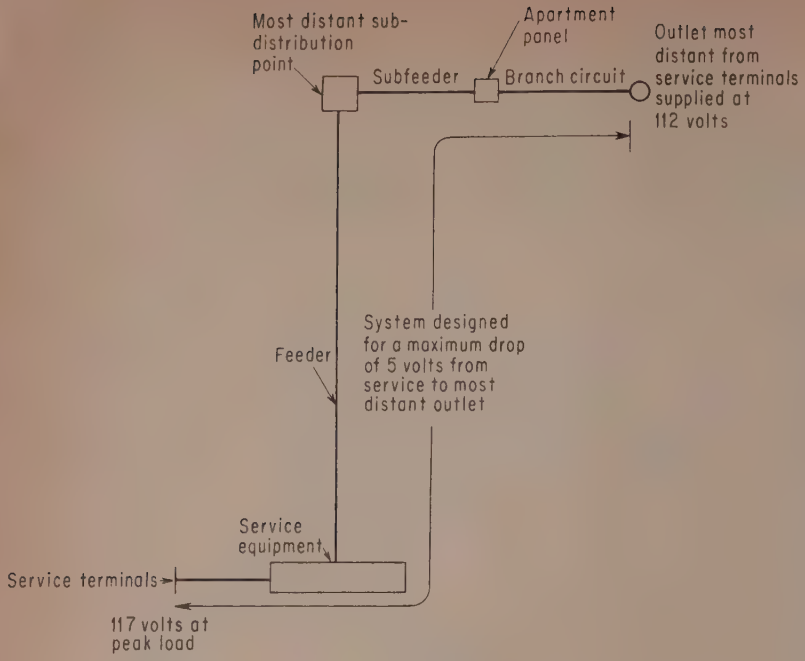
Lumen drop is the criteria, but where is this critical? In the kitchen or bathroom? No; these are most likely fluorescent. Halls, closets, bedrooms? No again; essentially these are secondary-use spaces, lightingwise. Dining room? Almost as extinct as the dodo; very limited use at the best, certainly not critical from a lighting standpoint. This leaves us the living room, and here light quantity is a must—or is it? Can any light source be more wasteful of lumens than are madam's ideas of decoration? And if she is short of lumens with a 60-watt lamp, how about using a 75 or, for that matter, a 150? All things considered, no gray hairs on this score seem warranted. Certainly a copper mine should not be installed in the building to give her a few more lumens, (so she can have more opaque shades on her lamps). Seriously, what should be the voltage at the lamp outlet, assuming the use of a 120-volt lamp?

If we assume 112 volts as the socket voltage, we have a drop of 8 volts (on the 120-volt base), or 6.66%, and a lumen loss of only about 11%. Let us therefore tentatively use 112 volts as the acceptable socket voltage for lighting. This will permit a drop of (117-112 or) 5 volts in the wiring system at the assumed peak voltage. If any eyebrows are raised comparing this to the 1.2 volts (i.e., 1%), present thinking, so much the better.

Heating Devices—In commercial, institutional and industrial buildings these are normally of little importance or, contrariwise, of major importance. But if critical voltage-drop conditions arise in specific instances, this becomes a problem with which the designer can well cope. In any event, no safety considerations, only matters of time or efficiency, are involved.

In residential (apartment) buildings, however, the story is different. Heating devices (irons, toasters, ranges, dryers, etc.) become more important every day. But low voltage, within reasonable limits, results only in stretching the time of performance. This can become an unmitigated nuisance, but hardly a matter for code safety concern. However, let us examine the situation: what are the low limits?

First, it should be borne in mind that heating devices are nameplate rated 115 volts, not 120. Suppose we now assume an end voltage of 112, as for lighting; resulting wattage is as the square of the voltage, i.e.,


Most distant sub-distribution point
Apartment panel
Outlet most distant from service terminals supplied at 112 volts
Subfeeder
Branch circuit
System designed for a maximum drop of 5 volts from service to most distant outlet
Feeder
Service equipment
Service terminals
117 volts at peak load

REALISTIC VOLTAGE DROP PLAN FOR APARTMENT HOUSES

$(112/115)^2$ or 95% of the rated heat output. One must, in all seriousness, ask—so what? Raising our voltage means copper and that means money—usable to much better advantage for other enlargements of the electrical system. So let's tentatively establish 112 volts as the socket criteria for heating devices also.

Motor Driven Devices—These are critical to low-voltage conditions, both from a safety and use standpoint. How long can we go and still stay within bounds. Let us therefore consider the apartment house with its multiplicity of small motor-driven devices, (refrigerators, washers, air conditioners, etc.). Again, all such devices are presently nameplate rated for 115 volts. Device manufacturers say that their motors will operate on 10% voltage variation both plus and minus i.e., 104 to 126 volts; but it would be questionable to even approach the low limits. We feel that 5% under-rating should not be exceeded, otherwise serious abuses may materialize.

Using 5% then, we find the minimum operating voltage can be 115-(115 x .05) = 109.25 (let's say 110). On the 120-volt nominal supply basis, we can then afford 10/120 loss, i.e., an 8.3% drop, service to motor. However, if we keep to the 112-volt limit discussed for the previous devices, we have a safety margin of 8 volts and have only 8/120 or 6.7% drop. So far, so good.

Electronic Devices — Commercial and industrial use calls for specific study of each case; this we can safely leave to the designer. But in apartment use, television, specifically, is another matter (radio is not too critical). Voltage needs depend on many factors, such as make and age of set, for instance. Nothing here is accurately predictable, but we can establish some criteria based on television experience.

Authorities in the television field tell us that sets are nameplate rated at 115 to 117 volts, but that low-voltage limits should not be below 112 volts, although the better grade sets can tolerate 108 volts. So we're right back to our 112-volt thinking—for the howls of anger from the family whose picture is distorted, shrunk or unstable, is something a landlord cannot abide, no matter how thick his hide. And if he can pass this hot potato on to his engineer or contractor, or both, their lot is not to be envied. So, in self-protection, 112-volt minimum it is; and we're back to the permissible drop as for lighting, i.e., 5 volts.

Having established 5 volts as the maximum allowable drop on a 120-volt nominal supply, let us now consider a specific example of what this means in a fair-sized apartment project, supplied with the almost universal 120/208-volt, 3-phase, 4-wire system. We will take a project typical of the conditions we want to study—a 15-story, moderate rental ($40 to $60 per month per room, if one can forgive calling this moderate) building with ten 4½-room apartments per floor, each apartment modernly equipped. Demand loads are established on the 1959 NEC basis—i.e., 3 watts per sq ft for lighting, 3000-watt appliance load, a dishwasher, one 1½-hp air conditioner unit for the living room, two ¾-hp (7.5 amp units), for the bedrooms. There is no electric cooking, no clothes washers or dryers.

Apartment Unit Load

1. Lighting—1000 sq ft
   @ 3 watts = 3.0 kw
2. Appliance load 3.0 kw
   6.0 kw
3. Apply demand factor
   3.0 × 100% = 3.0
   3.0 × 35% = 1.0
   Net lighting and appliance load 4.0 kw
4. Add at 100% demand:
   One dishwasher
   (fixed appliance) 1.5 kw
   One 1½-hp air conditioner
   (10,000 Btu) 1.8 kw
   Two ¾-hp air conditioners
   (6,500 Btu) 2.0 kw
   Total load after demand 9.3 kw
5. Amperes, 120/208-volt open Y
   (i.e., 3-wire) 38.8
6. Subfeeder size per phase leg No. 8

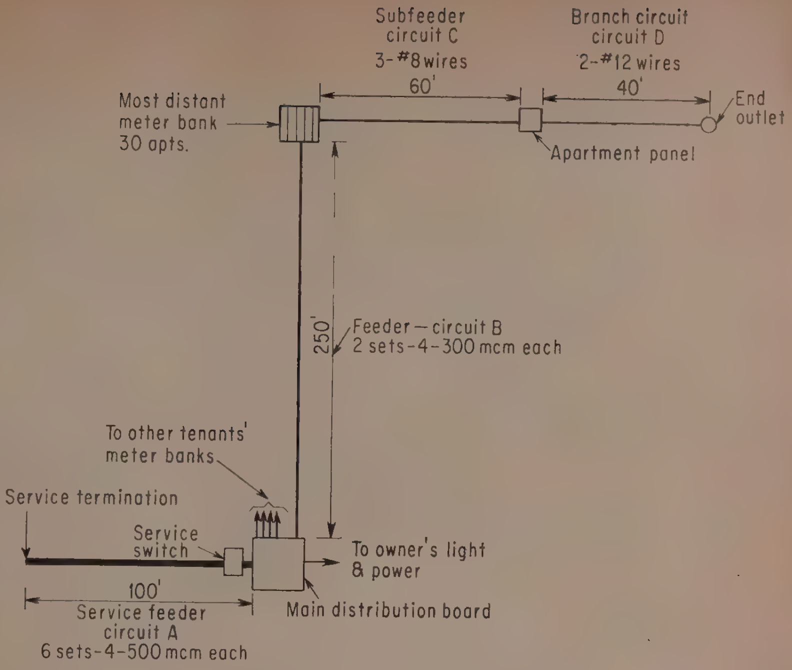
Feeder Load to One Meter Bank

Apartments are individually metered. Meters are located in centralized tenant floor meter closets, one such closet supplying three entire floors, i.e.,—30 apartments.

1. Lighting and appliance load,
   30 apartments
   @ 6 kw = 180 kw
   Apply demand factor—
   3.0 @ 100% = 3.0
   117.0 @ 35% = 41.0
   60.0 @ 25% = 15.0
   Net load,
   lighting and appliance— 59.0 kw
2. Dishwashers—30 × 1.5 = 45 kw
   Apply demand factor of 75%,
   net load 34.0 kw
3. Air conditioner load,
   30 × 3.8 kw at 100% = 114.0 kw
4. Total feeder load to one
   meter bank 207.0 kw
5. Amperes, 3-phase, 4-wire,
   120/208 volts 575
6. Cable size—Two 300 MCM
   (RH, copper) per phase.

Service Feeder Load

Tenant's Load—150 Apartments:
1. Lighting and appliance load,
   150 Apartments @ 6 kw = 900 kw



FEEDER SYSTEM FOR 150-UNIT APARTMENT HOUSE

Apply demand factor,
120 kw @ 35% = 42 kw
780 kw @ 25% = 195 kw
Net lighting and appliance load 237 kw
2. Dishwashers 150 × 1.5 = 225 kw
Apply demand factor 25%
(see Note A) Net load, 56 kw
3. Air conditioner load
150 × 3.8 = 570 kw
Apply demand factor 75%
(see Note B) Net load, 427 kw
4. Total Net tenants' load 720 kw
5. Add owner's load—public lighting, elevators, boiler room, laundry, pumps, etc. 103 kw
6. Total Load on Service 823 kw
7. Amperes, 3-phase, 4-wire, 120/208 volts, 2280
8. Cable size—six 500 MCM (RH copper) per phase.

NOTE A—No warrant exists in the code for this demand factor. However, common sense dictates it is inconceivable that 75% of all dishwashers, i.e., 112 of them, would be operated at one time and long enough to exert a thermal effect on the cable. In fact, in this respect, NEC Table 220-8 for household dryers sets an example of realism and the figure of 25% is taken therefrom.

NOTE B—Again, no warrant exists for this demand factor. Certainly this is a demand which will approach the connected load. But we are considering here, a total of 3 × 150 = 450 units. Experience has demonstrated (in New York City, at any rate) that there is a use factor due to such considerations as families being away, units out of order, bedrooms not used, personal dislike of air conditioners, etc. We think our use of 75% is conservative. At any rate, this being a study of voltage drop and not of feeder design, we trust the reader will not be overly critical of this assumption.

Voltage Drops

In the preceding section we determined what cable sizes are required to satisfy adequate current carrying needs. We now study the problem of:

(I) What would our voltage drop be (to the final use point in the apartment), using the cable sizes determined above, i.e., thermal sizing only:

(II) What cables would we need for a total of 5 volts drop, service to use-point.

(III) What cables would we need for limiting the drop in the feeders to 1%.

To state the obvious, voltage drop calculation requires the need of establishing the following factors: cable sizes involved; distances, i.e., lengths of each circuit component; ampere loads in each circuit, and the power factor thereof; types of raceway employed, i.e., whether magnetic or non-magnetic; unit voltage drop factors to be used.

(1) Cable Sizes—limited in our example to No. 12, No. 8, 300 MCM and 500 MCM. All 600-volt rated; four individual wires per conduit, in feeders; three in subfeeders; two in branch circuits.

(2) Distances—The accompanying diagram of the feeder system for a 150-unit building is used to establish these typical distances:

Circuit A—Service feeder, as 100 ft.

Circuit B — Feeder service switch to the furthest meter bank —250 ft.

Circuit C—Longest subfeeder from the meter to the individual apartment fuse cutout—60 ft.

Circuit D—The final branch circuit—40 ft.

We might here note that Circuit A will, more often than not, be much shorter, to the point of being zero. Our example purposely uses a garden type project, where the utility stops at the property line. But, the length of Circuit A might sometimes be 200 ft or longer.

(3) Ampere loads per wire then become as follows:

Circuit A—2280 amps—6 wires per phase = 380 amps
Circuit B—575 amps—2 wires per phase = 238 amps (use 240).
Circuit C— = 39 amps (use 40).
Circuit D—Assumed as No. 12 wire and a 1200-watt load = 10 amps

(4) Raceways—We will develop figures for both magnetic and non-magnetic types. Outside cables can well be direct-burial type or in fiber conduit. Inside, the use of aluminum conduit or aluminum armor is now a reality. These, of course, are all non-magnetic. In the magnetic, there is the old faithful—steel.

(5) Unit Voltage Drops—Here we tread on uncertain ground. Personally, we do not feel that firm factual data exists. But we have available a composite table, which tabulates 14 sources of drop data. The most widely used (though not the lowest), appears to be the data listed in the "Electrical Engineering Manual" of the International Association of Electrical Inspectors; this has been successfully applied in the New York area for some years. We believe it can be well used for our purposes. The data shown are for magnetic raceways, and are given in volts-drop-per-100 amps for 100 ft (10,000 amp ft). We will use the phase-to-neutral drop in each instance. Non-magnetic duct figures will be taken as 80% of the magnetic.

(6) Our next step is to establish the power factor to be considered and applied to each circuit. We propose to use:—

For Circuit	D — branch circuit	— 1.00
" "	C — subfeeder	— 0.98
" "	B — feeder	— 0.98
" "	A — service feeder	— 0.97

There will probably be some differences of opinion on these figures; but since, as far as we know, no factual data exist on this point and since much lower figures are not conceivable, the results cannot be far wrong. The IAEI tables run 1.0 pf and 0.90 pf; we will interpolate where necessary.

(7) We now establish our unit voltage drop from the IAEI tables:—

LINE TO NEUTRAL DROP—
VOLTS PER 10,000 AMP FT

	No. 12 Wire 2-wire, 1-phase CIRCUIT D	No. 8 Wire 3-wire, open Y CIRCUIT C	300 MCM 4-wire, balanced Y CIRCUIT B	500 MCM 4-wire, balanced Y CIRCUIT A
Magnetic Ducts				
1.0 pf	33.0			
0.98 pf		10.0	0.40	
0.97 pf				0.25
Non-magnetic Ducts				
0.98 pf			0.32	
0.97 pf				0.20

Note—No non-magnetic data used for Circuits D and C; these are invariably steel conduits.

(8) The multiplying factors needed to convert the 10,000-amp-ft findings in the above table to the actual volts drop of our specific circuits are as follows:—

Circuit D — 10 amps × 40 ft = 400-amp ft = $\frac{400}{10,000}$ = 0.04
Circuit C — 40 amp × 60 ft = 2,400-amp ft 0.24
Circuit B — 240 amps × 250 ft = 60,000-amp ft 6.00
Circuit A — 380 amps × 100 ft = 38,000-amp ft = 3.80

(9) Now we are ready for the actual voltage-drop figures for our building:—

Magnetic Ducts:	Drop	% of 120 Volts
Circuit D—33.0×0.04	=1.32 volts	1.1
C—10.0×0.24	=2.40 volts	2.0
B—0.40×6.00	=2.40 volts	2.0
A—0.25×3.80	=0.95 volts	0.75
TOTAL DROP	7.07	5.85%

Non-Magnetic Ducts:	Drop	% of 120 Volts
Circuit D—1.32 v×100%	=1.32 v	1.1
C—2.40 v×100%	=2.40 v	2.0
B—2.40 v× 80%	=1.92 v	1.6
A—0.95 v× 80%	=0.76 v	0.63
TOTAL DROP	6.40	5.33%

Bearing in mind that 5-volt drop was our maximum desired (from the assumed 117 volts at the supply end during peak load), we find that using cables sized for only the required current-carrying capacity, we cannot quite reach even that liberal limit. We further find that lowering the drop by the 1.40 volts still needed (using the favorable non-magnetic raceway) presents problems. Let us analyze where and how we can effect a lower drop:—

(a) In Circuit D?—Hardly. Increasing the wire size to No. 10 or larger presents practical construction difficulties, both electrical and mechanical, which all contractors will immediately recognize, and which, in any event can produce little benefit.

(b) In Circuit C?—Yes, at some cost. If we increase the wire size to No. 6 we can achieve a decrease of about 1 volt, but at the cost of the next larger size of conduit (1 in.), as well as the wire, and of course, labor. Considering that there are 150 of these circuits, all of which would be affected, an increased cost of some $1500 is indicated.

(c) In Circuit B?—Yes, also at some cost. To achieve the further ½-volt decrease needed, we would have to increase the cable to 400-MCM and the conduit from 3″ to 3½″. There are five of these risers in our building, but only about three would be affected. Total length of affected feeder would be 250 × 3 × two (parallel legs), or 1500 ft, which, at about $3.00 per foot, is $4500.

(d) In Circuit A—No. Any increase here would be enormously costly and hardly effective. If we increase Circuits B and C above shown, there will be no need to change Circuit A.

(e) We therefore conclude: even using the 5-volt limit (4.17% on 120-volt base) increased costs are likely to develop in relation to cost of thermal-sized conductors only.

1% Drop—The 1% drop figure as now used is generally limited to the "feeder" system; i.e., in our example Circuits A and B. The minimal drop found in the computation for non-magnetic raceway above, for these circuits, is 2.68 volts. The enormity of the problem of dropping this to 1.2 volts (i.e., 1%) is self evident and needs no elaboration. We must therefore consider this 1% criterion as impossible of achievement as well as, we believe, unnecessary.

General Conclusions

Let us now summarize the results of the above study; what do we find?

1. That, for all practical purposes, if we have 112 volts at the final socket we have a safe and practical working figure upon which voltage drops can be based.

2. That, under average conditions, if we allow for a 5-volt drop, service point to socket, we can be reasonably certain of getting the 112 volts even if the service voltage at peak loads drops to 117 volts, (from the nominal 120 volts). On the basis of percent drop, we can safely allow 4.5% figured on 120 volts.

3. That of the 4.5%, there should be allocated 1.0% as the drop in the branch circuit, (since the use of No. 12 wire is practical in all instances.)

4. That this leaves 3.5% as the allowable drop in the service, feeder and subfeeder runs.

5. That 3.5% drop is achievable in many instances without any increase in the sizes of cables based only on current-carrying capacity. This is probably achievable with very modest increases in cost in most other cases.

6. That the limitation of drop to 1% is impossible and unnecessary to achieve and tends to inhibit the expansion of our electrical systems. That such expansion is by no means confined to the uses we already take for granted (dishwashers, garbage disposals, clothes washers, air conditioners, television, etc.), is well illustrated by two new developments: (1) the advent of the 5-kw combination washer-dryer, with its small space needs, and (2) the use of electric space heating, already launched on apartment house scale, made competitively feasible by, strange as it may seem, the advent of air conditioning. Let us therefore place no more burden on our wiring costs than is necessary for safety and practicality of use. Our industry is no exception to the rules of economics—the lower the cost of your product, the easier the sale.

Over-Voltage

We search in vain through our technical literature for discussions

(Continued on page 241)

• *ESTIMATING FORUM—IV*

By Ray Ashley, Research and Consulting Engineer, Oak Park, Ill.

Project Type and Risk Affect Job Selection

STATEMENT:

Electrical contractor Jones regularly submitted bids to a certain architect, but had not been awarded a contract for a long time. Finally, the architect advised him that he was close to the low bid on two jobs and that he could have either one if he met the low figure.

The projects and bids were as follows:

No. 1—A Hospital Addition. Low bid was $27,750. Jones' bid was $28,320 or $570 high.

No. 2—An Industrial Project. Low bid was $25,750. Jones' bid was $26,600 or $850 high.

To the architect's surprise, contractor Jones selected the industrial project which required the biggest cut in his bid price and was, in effect, a smaller contract.

QUESTION:

Did Jones exercise good business judgment in his choice of the industrial project?

ANSWER:

Yes. The industrial project offered less risk; would be of shorter duration; had a better labor-material ratio.

DISCUSSION:

To implement the discussion, methods of estimating used by each contractor are shown. For simplicity, the same base cost was used for both contractors. The difference appears in the markups used and the method of applying them. Figs. 1 and 2 represent Jones' and the low bidders hospital estimates. Figs. 3 and 4 represent Jones' and the low bidder's industrial project estimates. Fig. 5 represents Jones' revised estimate to get the industrial job.

Job duration is an important consideration on any project. On an industrial job, start of the electrical work may be delayed by progress of the general contractor. Once started, chances of proceeding without further delay are very good. Throughout the life of a hospital job, progress of electrical work is governed by other trades. The work not only costs more, but job duration is much longer.

Dollarwise, these two projects are quite similar. For this industrial project, assume normal duration to be 16 weeks. The same payroll on a hospital job would very likely represent a duration twice as long. And remember, the hospital payroll (Figs. 1 and 2) was $10,800 compared to $8,000 (Figs. 3 and 4) for the industrial work.

Contracts for material involve less risk than do those for labor. This was an influencing factor in Jones' choice of projects. The material-labor ratio of the industrial job was substantially more inviting.

Under the pressure of estimating and bidding jobs, we are inclined to forego a thorough analysis of the work being figured. However, when given a chance to meet a low bid, we really go to work. That is what happened in Jones' case. While reviewing his estimates, Jones discovered he had used the same markups for both jobs. He then realized that the industrial

(Continued on page 210)

FIG. 1—JONES' HOSPITAL ESTIMATE

		MATERIAL		LABOR
Base costs (material purchase)		$10,500	Payroll	$10,800
Direct job expense (material)	2%	210		
Direct job expense (labor)	6%	648		
		$11,358		$10,800
Overhead	8%	909	30%	3,240
Complete job costs		$12,267		$14,040
Return	5%	613	10%	1,404
Sell price—Material		$12,880		$15,444
Sell price—Labor		15,444		
Sell price—The Job		$28,324		

Bid Price $28,320

Luminous Dome Solves Glare Problem

Smith Electric Company of San Francisco designed and installed a unique skylight installation; using coupled fluorescent strip-lights, messenger-cable suspension, sliding relamping techniques and aluminum canopy in confined attic space where accessibility was difficult.

UNTIL a few months ago, anyone visiting the San Francisco headquarters of the California Pacific Title Insurance Company undoubtedly would have been annoyed at the extreme fluctuations in general illumination, for a 40-ft-dia shallow-domed central skylight would deliver as much as 700 foot-candles to counters and desktops at high noon on sunny days, although clouds or fog in the late afternoon could cut this level to as little as 10 or 8 fc.

These wide variations were due to the fact that the frosted-glass skylight was surmounted by a second pyramid-shaped clear-glass exterior roof structure, a combination that translated daily and seasonal outdoor weather conditions into interior extremes of glare and gloom.

Between skylight and exterior glass roof, thirteen 500-watt floodlights had been installed in an endeavor to raise the lower limit of lighting intensity, but these lamps were too few in number to achieve their purpose. Spacing between fixtures was too great to obtain even illumination of the skylight's surface, and glass used for panelling the skylight was too dense to efficiently transmit artificial illumination to working areas located 28 ft beneath it.

For these several reasons, Title officials invited Warren G. Smith, president of Smith Electric, to study the problem and submit proposals for solving it. It was stipulated, however, that the overall architectural appearance of the ceiling would not be altered; the resulting lighting treatment would provide at least 50 footcandles of general illumination; relamping and maintenance would be accomplished from within the confined space above and around the domed skylight; and no scaffolding would be erected on the central office floor.

After investigation of local conditions and conferences with architects and consultants, Smith came up with a triple solution that reflects considerable ingenuity.

MID-DAY GLARE and afternoon gloom formerly created lighting variations to range from 700 to 8 footcandles beneath this 40-ft-diameter skylight. Replacement of dense glass dome panels, installation of sliding fluorescent fixtures and creation of aluminum canopy now provides even 50-fc intensity to desks and counters 28 ft below.

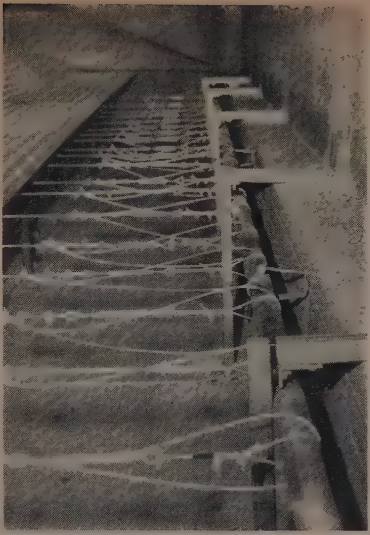
NEARLY 300 PANELS of various sizes and shapes were cut from Plexiglas and installed in original inverted-T skylight framework to replace glass sections which were too densely frosted to efficiently transmit artificial illumination provided by a few 500-watt incandescent floodlights.

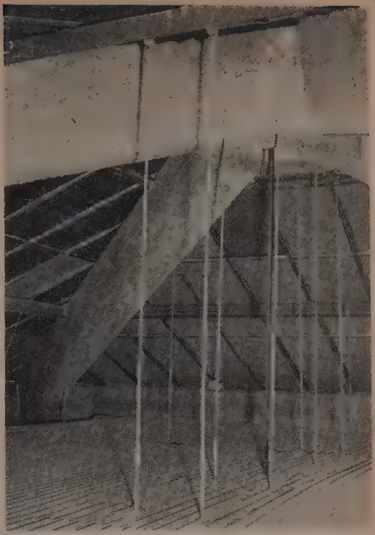
First, to improve light transmission and diffusion characteristics, all inverted-T framing members of the skylight were left in their original positions, although the dense glass panels were replaced by sections of ⅛-in.-thick Plexiglas. Since there are 288 sections of various sizes and shapes, the removal of old panels, precision cutting of Plexiglas duplicates, and replacing these new sections in the original skylight frame was a delicate, tedious operation.

Second, to obtain even, high-level illumination to top-light the new skylight, it was decided to remove the original 13 incandescent fixtures and to install in their place a total of 188 rapid-start fluorescent lamps which would be mounted in continuous rows of various lengths. Distances between rows, and also between lamps and skylight surface, was to be approximately 20 in.

This decision proved to be simpler in theory than in actual attainment because, since maintenance and relamping had to be accomplished from the narrow crawl-space surrounding the central dome, the fluorescent strips could not be secured in fixed, inaccessible positions above the skylight.

This problem was solved by installing 24 equally spaced rows of steel airplane-control cable (tested for 2000-lb stress) across the dome, securing the cables at either end by turnbuckles and clevis anchors attached to horizontal pipe racks which, in turn, were secured to adjacent parapet walls by lipped-channel brackets and pipe clamps.


AIRPLANE CONTROL CABLES, used to support fluorescent lampstrips, are secured to terminal pipe racks by means of turnbuckles and clevis anchors. Pipes are secured to masonry parapet walls by means of lipped-channel brackets and pipe clamps; these anchoring mediums being fastened to concrete deck and parapets by powder-driven studs.

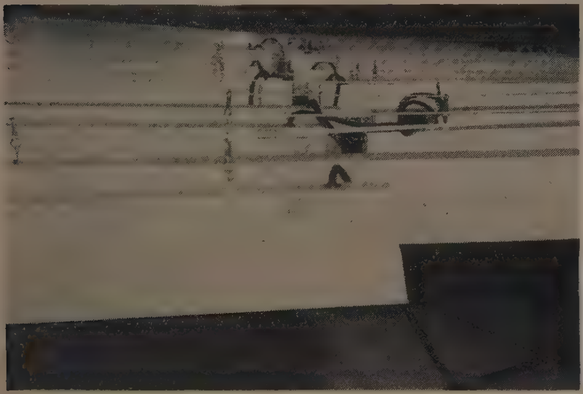

CORRUGATED ALUMINUM canopy is supported by rod hangers attached to purlins and hip beams of exterior roof. Hangers also continue through "umbrella" to support central strong-back which, in turn, lifts midpoints of cables slightly in order to maintain equidistant gap between lampstrips and shallow-domed skylight surface.

Midpoints of cables were raised slightly by a central channel strong-back member suspended by rod hangers secured to exterior-roof purlins, a procedure that resulted in cables remaining approximately equidistant above the skylight for its full width. Anchoring of channel brackets and pipe clamps to the masonry parapet walls was accomplished by using powder-driven studs.

Fluorescent lamp chassis (including 4- and 2-ft lengths) were then equipped with snap-rings on top and end sections, thereby making it possible to couple the fixtures together in tandem, and to suspend them on the dome-spanning messenger cables. Ends of chassis were likewise equipped with short lengths of 3-conductor rubber-insulated connection cords and twist-lock plugs in order to couple the lampstrips electrically as well as mechanically.

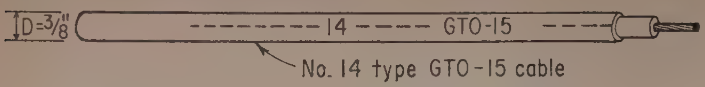
With lampstrips so equipped, it was then possible to progressively snap fixtures to messenger cables, slide them out over the skylight, couple next-in-line chassis to them, and continue in this manner until all rows extended outwards to reach

(Continued on page 242)


EVEN ILLUMINATION of skylight is now obtained from 188 rapid-start fluorescent lamps. Note snap-rings on tops and ends of fixtures to permit attachment to supporting messenger cables and coupling of chassis in tandem. Electrical connection of lampstrips is by means of short flexible leads and twist-lock plugs.

LAMPSTRIP CHASSIS at ends of rows are equipped with longer flexible leads and plugs that connect into duplex receptacle boxes positioned around the skylight rim. Connection of receptacles for circuiting purposes is via curved lengths of rigid conduit. Lighting installation represents electrical load of 9 kw.

Area of Odd-Sized Conductor



What size conduit would be required for two No. 14, 15-kv neon sign cables? The diameter of each cable is ⅜ in. (.375).

$CSA = D^2 \times .7854$

$CSA = (.375)^2 \times .7854$

$CSA = .1104$

Total cross-sectional area for both cables is $.1104 \times 2 = .2208$. According to the conduit percentage fill at the bottom of Table A, a 1-in. conduit would be required.

How to compute . . .

Conductor Fill In Raceways

With the 1959 NEC permitting more than nine conductors in conduits, the possibility of different sizes of conductors occupying the same raceway has been greatly increased. New tables are offered to simplify calculations for estimators and designers who must determine raceway sizes in combinations not shown in present NEC tables. Examples are given to explain the application of the tables, and a general discussion follows.

By J. H. Watt

ONE of the most significant changes incorporated in the 1959 NEC was the removal of the 9-wire restriction in conduits for general wiring. As a result of this revision, the number of conductors that may occupy a conduit is limited only to a maximum fill of 40% of the cross-sectional area of a given size conduit.

Table 1 of Chapter 9 (1959 NEC) gives the maximum number of conductors of equal sizes for each respective conduit size. And this table applies to new installations of conduits.

When installing different conductor sizes, the proper conduit size is computed according to NEC Tables 3 through 7, Chapter 9. And with a large number of different conductor sizes, this requires a considerable amount of arithmetic to arrive at the proper size conduit. Since most of these computations are made in the design stage, the tables in this article have been compiled to simplify the procedure. The advantage to these supplemental tables is that the only arithmetic involved is simple addition, plus moving a decimal point in some instances. Multiplying is eliminated, and with it, the chance of error so common in such problems.

Table A for New Work

Accompanying Table A applies to combinations of conductors not included in Table 1, Chapter 9 of the NEC. Conductor dimensions are those of Type RW conductors as given in Column 3 of NEC Table 5, Chapter 9. This is in accordance with the provisions of Section 346-6 (a-2), which specifies the use of rubber-covered conductor dimensions for new work as shown in Table 5, Chapter 9. And Table 5, Chapter 9 mentions the use of Type RW dimensions for No. 14 and 12 sizes, because Type R and RH conductors in these two sizes have smaller cross-sectional areas.

While accompanying Table A gives only the dimensions of the various conductor sizes up to a total of nine conductors, the figures may be used for any number by shifting decimal points one place to the right for each multiple of ten, and adding values for less than ten conductors.

As an example, assume that 27 No. 12, 14 No. 10, and 12 No. 6 conductors are to be installed in a conduit. The size of the conduit

TABLE A—Conductor and Conduit Area—Square Inches

Size AWG MCM	Combination of Conductors for New Work, Where Not Included in Table 1, Ch. 9, NEC For Size of Conduit or Tubing Required								
	1	2	3	4	5	6	7	8	9
18	.0167	.0334	.0501	.0668	.0835	.1002	.1169	.1336	.1503
16	.0196	.0392	.0588	.0784	.0980	.1176	.1372	.1568	.1764
14	.0327	.0654	.0981	.1308	.1635	.1962	.2289	.2616	.2943
12	.0384	.0768	.1152	.1536	.1920	.2304	.2688	.3072	.3456
10	.0460	.0920	.1380	.1840	.2300	.2760	.3220	.3680	.4140
8	.0760	.1520	.2280	.3040	.3800	.4560	.5320	.6080	.6840
6	.1238	.2476	.3714	.4952	.6190	.7428	.8666	.9904	1.1142
4	.1605	.3210	.4815	.6420	.8025	.9630	1.1235	1.2840	1.4445
3	.1817	.3634	.5451	.7268	.9085	1.0902	1.2719	1.4536	1.6353
2	.2067	.4134	.6201	.8268	1.0335	1.2402	1.4469	1.6536	1.8603
1	.2715	.5430	.8145	1.0860	1.3575	1.6290	1.9005	2.1720	2.4435
0	.3107	.6214	.9321	1.2428	1.5535	1.8642	2.1749	2.4856	2.7963
00	.3578	.7156	1.0734	1.4312	1.7890	2.1468	2.5046	2.8624	3.2202
000	.4151	.8302	1.2453	1.6604	2.0755	2.4906	2.9057	3.3208	3.7359
0000	.4840	.9680	1.4520	1.9360	2.4200	2.9040	3.3880	3.8702	4.3560
250	.5917	1.1834	1.7751	2.3668	2.9585	3.5502	4.1419	4.7336	5.3253
300	.6837	1.3674	2.0511	2.7348	3.4185	4.1022	4.7859	5.4696	6.1533
350	.7620	1.5240	2.2860	3.0480	3.8100	4.5720	5.3340	6.0960	6.8580
400	.8365	1.6730	2.5095	3.3460	4.1825	5.0190	5.8555	6.6920	7.5285
500	.9834	1.9668	2.9502	3.9336	4.9170	5.9004	6.8838	7.8672	8.8506
600	1.1940	2.3880	3.5820	4.7760	5.9700	7.1640	8.3580	9.5520	10.7460
700	1.3355	2.6710	4.0065	5.3420	6.6775	8.0130	9.3485	10.6840	......
750	1.4082	2.8164	4.2246	5.6328	7.0410	8.4492	9.8574	11.2656	......
800	1.4784	2.9568	4.4352	5.9136	7.3920	8.8704	10.3488	......	......
900	1.6173	3.2346	4.8519	6.4692	8.0865	9.7038	11.3211	......	......
1000	1.7531	3.5062	5.2593	7.0124	8.7655	10.5186	......	......	......
1250	2.2062	4.4124	6.6186	8.8248	11.0310	......	......	......	......
1500	2.5475	5.0950	7.6425	10.1900	......	......	......	......	......
1750	2.8895	5.7790	8.6685	11.5580	......	......	......	......	......
2000	3.2079	6.4158	9.6237	......	......	......	......	......	......

% of Area	Use	½″	¾″	1″	1¼″	1½″	2″	2½″	3″	3½″	4″	5″	6″
31%	2 Cond.	.09	.16	.27	.47	.63	1.04	1.48	2.29	3.07	3.94	6.20	8.96
40%	4 or more	.12	.21	.34	.60	.82	1.34	1.92	2.95	3.96	5.09	8.00	11.56
43%	3 Cond.	.13	.23	.37	.65	.88	1.44	2.06	3.17	4.26	5.47	8.60	12.42
53%	1 Cond.	.16	.28	.46	.80	1.08	1.78	2.54	3.91	5.25	6.74	10.60	15.31

Note: For rewiring existing, concealed conduits, the conduit percentage fills at the bottom of Table C may be used.

is determined from accompanying Table A. If two No. 12's equal 0.0768, then for 20 No. 12's, move the decimal point one place to the right, which equals 0.7680. Then add to this figure 0.2688, which is given in the table for seven No. 12's. Thus, for 27 No. 12's, the total is 1.0368. Following the same method, 14 No. 10's are figured as follows:

10 No 10 = 0.4600 (decimal point moved one point to the right from single conductor figure)
4 No. 10 = 0.1840
14 No. 10 = 0.6440

And for 12 No. 6's:

10 No. 6 = 1.2380 (decimal point moved one point to the right from single conductor figure)
2 No. 6 = 0.2476
12 No. 6 = 1.4856

Adding the three sub totals,

27 No. 12 = 1.0368
14 No. 10 = 0.6440
12 No. 6 = 1.4856
Total sq. in. area = 3.1664

Referring to the 40% conduit fill figures at the bottom of Table A, a 3½-in. conduit would be required.

If an adding machine is close at hand, the total cross-sectional area of any combination of conductor sizes can be computed in less than a minute. But in using a standard adding machine, forget the decimal points that appear on the adding machine tape. In Table A, you will notice that four figures always appear to the right of the decimal point for each value. And with an adding machine, bear this in mind, For 20 No. 12 conductors, 7680 will appear on the adding machine tape, because 0.0768 for two No. 12's becomes 0.7680 for 20 No. 12's (decimal is moved one place to the right and a zero added at the end to maintain a 4-place decimal alignment). Here's how the previous example is tabulated on an adding machine tape for 27 No. 12, 14 No. 10, and 12 No. 6 conductors from the values given in Table A:

7680 (20 No. 12—0.7680)
2688 (7 No. 12—0.2688)
4600 (10 No. 10—0.4600)
1840 (4 No. 10—0.1840)
12380 (10 No. 6—1.2380)
2476 (2 No. 6—0.2476)
31664 Total

Now take the figure 31664 and count off four decimal places to the left. The result is 3.1664, which is the same as in the previous example, and represents the total cross-sectional area of the conductors under consideration.

Smaller combinations, such as three No. 10's and three No. 4's, can be computed simply by glancing at Table A. The value for three No. 4's is 0.48+, and for three No. 10's the value is 0.13+. Then the total is 0.61+. From the 40% conduit-fill figures at the bottom of Table A, a 1½-in. conduit would be required.

Rewiring Existing Conduits

As previously discussed, Table A applies to new conduit installations where, in general, conductor fill is limited to 40% of the interior cross-sectional area of a conduit. Such a limitation on an original installation simplifies the addition of more branch circuits or larger feeders where load requirements are increased in the future.

With this thought in mind, the NEC permits a greater percentage fill of conductors in an existing conduit in addition to allowing the use of actual conductor insulation dimensions in making computations. For rewiring existing raceways for increased load where it is impractical to increase the size of the raceway due to structural conditions, NEC Table 3, Chapter 9 permits three or more conductors to occupy 50% of the interior cross-sectional area of a conduit. For a single conductor, 60% fill is permitted, and two conductors may occupy a 40% fill. And to be consistent with an official interpretation issued a number of years ago, this increased percentage fill applies only to existing concealed conduits. Therefore, the calculations in the accompanying Tables B and C are intended for the rewiring of existing concealed conduits. If used for other than this, approval should be obtained from the code authority having jurisdiction.

Accompanying Table B gives the maximum number of small-diameter conductors of equal sizes permitted in existing concealed conduits, and the dimensions and computations are based on NEC Tables 3, 4, and 5, Chapter 9.

A practical example of Table B would be: An existing concealed ½-in. conduit can contain up to eight No. 12 TW conductors; or 15 No. 12 TW conductors are permitted in a ¾-in. conduit. In both cases, the conductor fill does not exceed 50% of the conduit cross-sectional area.

TABLE B—Maximum Number of Small Diameter Conductors Permitted Where Rewiring Existing Concealed Conduits. Types T, TW, *RU, *RUH, **THW, ***R, and ***RH

Size AWG or MCM	Maximum Number of Conductors in Conduit or Tubing											
	½	¾	1	1¼	1½	2	2½	3	3½	4	5	6
18	17	30	48	85	115	190						
16	13	24	39	68	93	154						
14	11	19	31	55	75	124	177					
12	8	15	25	43	59	97	139	214				
10	6	11	19	33	45	75	106	164	220			
8	3	6	10	18	25	41	58	90	121	155		
6	1	3	5	9	12	20	29	45	60	77	122	176
4	1	1	3	6	9	15	22	33	45	58	91	132
3	1	1	3	5	8	13	18	29	39	50	79	114
2	1	1	2	5	6	11	16	25	33	43	67	98
1		1	1	3	5	8	11	18	24	31	49	71
0		1	1	3	4	7	10	15	20	26	42	61
00		1	1	2	3	6	8	13	17	22	35	51
000			1	1	3	5	7	11	15	19	30	43
0000			1	1	2	4	6	9	12	16	25	37
250			1	1	1	3	4	7	10	13	20	29
300				1	1	3	4	6	8	11	17	25
350				1	1	2	3	5	7	10	15	22
400				1	1	1	3	5	7	9	14	20
500				1	1	1	2	4	5	7	12	17
600					1	1	1	3	4	6	9	14
700					1	1	1	3	4	5	8	12
750						1	1	3	4	5	8	11
800						1	1	2	3	4	7	11
900						1	1	2	3	4	7	10
1000						1	1	1	3	4	6	9
1250						1	1	1	2	3	5	7
1500							1	1	1	2	4	6
1750							1	1	1	1	3	5
2000								1	1	1	3	4
***14	6	11	18	32	44	73	104	160				
***12	5	9	15	26	36	60	86	132	178			
**14	7	12	20	36	49	81	116	179				
**12	5	10	17	29	40	66	95	147	197			
**10	4	8	13	24	32	54	77	118	159	204		
** 8	2	5	8	14	19	31	45	70	94	120	190	

Notes:

* Made in sizes 14 to 2 only.

** THW sizes from 14 to 8. All other THW sizes have same dimensions as T.

*** R and RH sizes with 2/64-in. insulation, 14 and 12 only.

At the bottom of Table B, the notes explain that Type RU and RUH conductors are made in sizes 14 to 2 only. And Type R and RH conductors, which have 2/64-in. insulation for sizes 14 to 12, have cross-sectional area dimensions in between those of Type RW and T conductors. Therefore, Table B includes specific calculations for such Nos. 14 and 12 Type R and RH conductors.

Table B also includes the maximum permissible number of Type THW conductors for sizes 14 to 8. It should be pointed out that Type THW conductors larger than No. 8 have the same dimensions as Type T or TW conductors, and conduit sizes are computed on this basis.

On the other hand, Type THW conductors, 14 to 8, have larger overall dimensions than those of Type T or TW. As a result, Table B contains separate calculations for these sizes of THW conductors, which are based on the following data:

	THW Dimensions	
Size	Dia.	Sq. In. Area
14	0.162	0.0206
12	0.179	0.0251
10	0.199	0.0311
8	0.259	0.0526

In NEC Table 3, Chapter 9, Type THW conductors are incorrectly listed as having the same dimensions as Type RW and RHH conductors. Since the appropriate NE Code-Making Panel has been advised of this error, it is likely that the next code edition will contain

TABLE C—Conductors and Conduit Area—Square Inches

Size AWG or MCM	Combination of Conductors for Rewiring Existing Concealed Conduits Where Not Included in Table B, With Type T, TW, RU, RUH, *R and *RH, **THW								
	1	2	3	4	5	6	7	8	9
18	.0088	.0176	.0264	.0352	.0440	.0528	.0616	.0704	.0792
16	.0109	.0218	.0327	.0436	.0545	.0654	.0763	.0872	.0981
14	.0135	.0270	.0405	.0540	.0675	.0810	.0945	.1080	.1215
12	.0172	.0344	.0516	.0688	.0860	.1032	.1204	.1376	.1548
10	.0224	.0448	.0672	.0896	.1120	.1344	.1568	.1792	.2016
8	.0408	.0816	.1224	.1632	.2040	.2448	.2856	.3264	.3672
6	.0819	.1638	.2457	.3276	.4095	.4914	.5733	.6552	.7371
4	.1087	.2174	.3261	.4348	.5435	.6522	.7609	.8696	.9783
3	.1263	.2526	.3789	.5052	.6315	.7578	.8841	1.0104	1.1367
2	.1473	.2946	.4419	.5892	.7365	.8838	1.0311	1.1784	1.3257
1	.2027	.4054	.6081	.8108	1.0135	1.2162	1.4189	1.6216	1.8243
0	.2367	.4734	.7101	.9468	1.1835	1.4202	1.6569	1.8936	2.1303
00	.2781	.5562	.8343	1.1124	1.3905	1.6686	1.9467	2.2248	2.5029
000	.3288	.6576	.9864	1.3152	1.6440	1.9728	2.3016	2.6304	2.9592
0000	.3904	.7808	1.1712	1.5616	1.9520	2.3424	2.7328	3.1232	3.5136
250	.4877	.9754	1.4631	1.9508	2.4385	2.9262	3.4139	3.9016	4.3893
300	.5581	1.1162	1.6743	2.2324	2.7905	3.3486	3.9067	4.4648	5.0229
350	.6291	1.2582	1.8873	2.5164	3.1455	3.7746	4.4037	5.0328	5.6619
400	.6969	1.3938	2.0907	2.7876	3.4845	4.1814	4.8783	5.5752	6.2721
500	.8316	1.6632	2.4948	3.3264	4.1580	4.9896	5.8212	6.6528	7.4844
600	1.0261	2.0522	3.0783	4.1044	5.1305	6.1566	7.1827	8.2088	9.2349
700	1.1575	2.3150	3.4725	4.6300	5.7875	6.9450	8.1025	9.2600	10.4175
750	1.2252	2.4504	3.6756	4.9008	6.1260	7.3512	8.5764	9.8016	11.0268
800	1.2908	2.5816	3.8724	5.1632	6.4540	7.7448	9.0356	10.3264	11.6172
900	1.4208	2.8416	4.2624	5.6832	7.1040	8.5248	9.9456	11.3664	12.7872
1000	1.5482	3.0964	4.6446	6.1928	7.7410	9.2892	10.8374	12.3856	13.9338
1250	1.9532	3.9064	5.8596	7.8128	9.7660	11.7192	13.6724	......	......
1500	2.2748	4.5496	6.8244	9.0992	11.3740	13.6488	......	......	......
1750	2.5930	5.1860	7.7790	10.3720	12.9650	......	......	......	......
2000	2.9013	5.8026	8.7039	11.6052	......	......	......	......	......
*14	.0230	.0460	.0690	.0920	.1150	.1380	.1610	.1840	.2070
*12	.0278	.0556	.0834	.1112	.1390	.1668	.1946	.2224	.2502
**14	.0206	.0412	.0618	.0824	.1030	.1236	.1442	.1648	.1854
**12	.0251	.0502	.0753	.1004	.1255	.1506	.1757	.2008	.2259
**10	.0311	.0622	.0933	.1244	.1555	.1866	.2177	.2488	.2799
** 8	.0526	.1052	.1578	.2104	.2630	.3156	.3682	.4208	.4734

% of Area	No. of Conductors	½"	¾"	1"	1¼"	1½"	2"	2½"	3"	3½"	4"	5"	6"
60%	1	.18	.318	.516	.90	1.22	2.016	2.87	4.43	5.94	7.63	12.00	17.33
40%	2	.12	.21	.34	.60	.82	1.34	1.92	2.95	3.96	5.09	8.00	11.56
50%	3 or more	.15	.265	.43	.75	1.02	1.68	2.395	3.69	4.95	6.36	10.00	14.445

* Nos. 14 and 12 only—Types R & RH—2/64-in. insulation. ** Nos. 14 to 8 only—Type THW. Other THW sizes have the same dimensions as Type T

similar dimensions of the Type THW sizes previously mentioned.

To illustrate the importance of stating the correct dimensions of THW conductors, assume that we have an existing concealed 2-in. feeder conduit, and that new feeder conductors are required to serve a load of 225 amps, 4-wire, 208Y/120 volts. If we assume that 4/0 THW conductors have the same dimensions as 4/0 RH, as implied in NEC Table 3, Chapter 9, four 4/0 conductors computed on this basis (1.9360 sq. in.) would exceed the maximum 50% fill permitted for the 2-in. conduit (1.68 sq in.). But using representative dimensions of THW, four 4/0's would have a total cross-sectional area of 1.5616 sq in., which is less than a 50% fill for the 2-in. conduit.

Accompanying Table C gives the dimensions of small-diameter wires for combinations not shown in Table B, and provides a simple method of determining the allowable fill of various conductor sizes for existing concealed conduits of given sizes.

When using Table C, follow the general instructions previously outlined for Table A, except, of course, that Table C conductor dimensions and conduit percentage fills apply only to rewiring existing concealed conduits.

For a typical application of Table C, assume an existing concealed 1-in. conduit. It is desired to install Type TW conductors of the following combinations: three No. 14's, three No. 12's, and three No. 6's. From Table C the dimensions are:

Conductors	Sq. In. Dimensions
3 No. 14 TW	0.0405
3 No. 12 TW	0.0516
3 No. 6 TW	0.2457
	0.3378 Total

(Continued on page 243)

Fresh Air and Humidity

Problems created by tightly insulated, electrically heated homes require refinements of existing practices to provide optimum comfort.

By **Glydewell Burdick,** *Wisconsin Power and Light Co., Madison, Wis.*

ELECTRIC heating is continuously excellent in the very cold weather, which is the most critical time. However, there are times when it could give better results, and at little extra cost. Today's way is to open a window or two when the air gets stuffy, stagnant, or too humid. We can do better than that. What are the conditions to be met, and what should be done to meet them?

Fresh Air

Our houses are tightly constructed, and properly so, to get infiltration down to about ½ air change per hr at the *design condition,* which usually means with a 15-mph wind at the coldest outdoor temperature. The natural air change will be less than that during most of the heating season, and in very mild and quiet weather may be almost none. If designed loosely (for one change per hr at the design condition), the situation in mild and quiet weather is little different than if designed for ½ change.

U. S. Navy experiments have shown that the minimum fresh-air requirement, without materially affecting human performance, is about 5 cu ft per min (cfm) per person. That gives a condition which can be tolerated, but it does not give comfort. For continuous occupancy, about 10 cfm per person is close to the minimum usually acceptable for comfort in residences. More is needed while cooking meals and for occupants smoking. Table 1 gives some applicable ASHRAE standards.

Take a 1200-sq-ft home as an example, having a volume of 9600 cu ft. One-half air change per hr represents 4800 cu ft per hr or 80 cfm. Without considering cooking or smoking, this is about the comfort minimum for eight people. Allowing for cooking and some smoking, it may be right for about four people.

The Electric Heating Forum is devoted to discussions of electric space heating practices and problems. A subject frequently debated is the effect of insulation on indoor humidity and available fresh air. This month Glydewell Burdick explores contributing factors and suggests future courses of action.

Currently being considered by many utilities and industry associations is the newly proposed "All-Weather Comfort Standard," the most significant portions of which are presented here, together with an explanation of the new R-numbers used by mineral wool manufacturers to describe the performance of their products.

Readers are invited to express their opinions; relate their own experience data to the material presented; or submit new ideas, research data, news, or case studies on any aspect of electric space heating. Please address correspondence to:

Electric Heating Forum
Electrical Construction and Maintenance
330 W. 42nd Street
New York 36, N. Y.

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Humidity

Normal home occupancy generates water vapor equal to about 25 pints of water per day according to published figures. We may assume that this varies considerably according to occupancy and family habits. With numerous house plants or uncovered crawl-space ground, for example, this figure would be materially exceeded. In the very cold weather this water vapor generation is good, and if it were not occurring we would have to humidify to keep the homes from being too dry. In the milder heating weather, however, there is likely to be too much water vapor.

Winter inside relative humidity desirable for health and comfort usually is in the range of 40 to 50%. Below 30%, static electricity sparks become an annoyance. The relative humidity which may safely be carried without impairment of insulation effectiveness or structural damage ranges from less than 10% for loosely constructed houses to something over 30% for tightly constructed houses with excellent vapor barriers, when the outdoor temperature is 0 deg F or below. At 30F outdoor temperature, the permissible range is from 35% for loose construction to about 50% for tight construction.

Moisture condensation on windows is also a limiting factor in cold climates. It is undesirable to carry an inside relative humidity above 35% for outdoor temperatures of 0 deg F and below, unless triple glass is used.

Heavy insulation is essential for economical operation of electric heating, as well as for the comfort of warmer walls, floors, and ceilings. An excellent warm-side vapor barrier is necessary to keep internally generated moisture from penetrating walls and ceilings, damaging wood framing, and impairing the effectiveness of the insulation. The inside vapor barrier should have a moisture permeability rating of *not more than* 1 *perm.* The outside "skin" of the house should have a rating of *not less than* 5 *perms*, so that such vapor as does leak into the walls or ceilings will have a chance to escape. Vapor barriers on insulation batts are inadequate because of the joints every 16 in.—and wood readily transmits water vapor. To assure a perm rating of 1, such joints would have to be sealed or overlapped at least 4 in. Batts of this type should be supplemented with a barrier such as a sheet of plastic, which comes in widths up to 16 ft. Such an excellent warm-side barrier also aids in reducing infiltration at the design condition to the ½ air change per hr wanted for economical operation.

A few people selling electric heating recommend omission of vapor barriers in ceilings. Presumably this is an attempt to get rid of part of the internally generated moisture without increasing the initial cost, hoping that attic ventilation will remove any moisture. Consideration of the known physical facts shows several serious consequences of this procedure:

(1) impairment of insulation effectiveness
(2) damage to the wood structure
(3) increased attic ventilation requirement
(4) lower safe limit of inside humidity
(5) increased heating energy requirement.

Resultant Indoor Relative Humidities for Various Rates of Fresh Air Intake

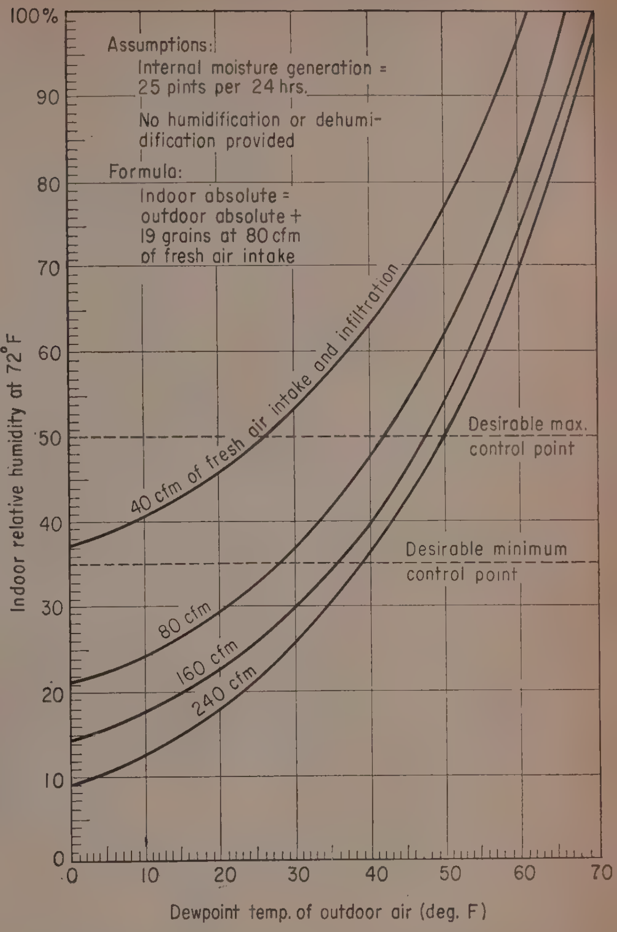


Table 1. Fresh Air Requirements

Occupancy	Fresh Air (cfm per person)	
	Recommended	Minimum
Residences, some occupants smoking	20	10
Offices	15	10
Retail stores	10	7½
General, occupants not smoking	7½	5
General, occupants smoking	40	25

Table 2. Practical Indoor Humidities

(Using Excellent Vapor Barriers)

Outdoor temperature	Indoor relative humidity
0 deg F and lower	35%
20F	40%
30F and higher	50%

Water vapor passing through the ceiling and its insulation condenses when it reaches the point where the temperature is the same as the dewpoint of the air which carries it. This soaks the insulation and adjoining framing. With changes in weather, the water or ice evaporates at times and accumulates at others. If the inside humidity is carried beyond a given point, the condensate will soak through and stain the ceiling. In the end, this is the most expensive way to get rid of air-borne moisture, as well as the least satisfactory.

Possible Solutions

With these considerations in mind, and assuming that the desirable structure, insulation, and vapor barrier are provided, it appears that the humidity control points shown in Table 2 are practical for electrically heated homes.

Table 3. Outdoor Dewpoint Temperatures

(Madison, Wis.)

Temperature (deg F)	Hours per year		
	Heating Season	Summer Season	Total
30 or lower	3744	42	3786
31 to 40	864	174	1038
41 to 55	858	690	1548
56 or above	342	2046	2388
Totals	5808	2952	8760

If 25 pints of water are internally generated each day, that quantity must be removed each day to hold the inside relative humidity at a constant level. With ½ air-change per hr (80 cfm), engineering calculations show that the inside air will have an absolute humidity 19 grains higher than the absolute humidity of the entering fresh air. At 40 cfm (¼ air-change per hr for 1200 sq ft), the differential will be 38 grains; at 160 cfm, 10 grains; and at 240 cfm, 6 grains.

The accompanying curves use these relationships to show resultant indoor relative humidities for 40, 80, 160, and 240 cfm intake of fresh air having outdoor dewpoints ranging from 0 to 70 deg F. It may be noted from the curves that, for our tight houses, mechanical exhaust or intake of outdoor air is a must at outdoor dewpoints much above 30F if indoor relative humidity is to be kept below 55%. Also, at dewpoints above 50F, forced ventilation at any reasonable rate fails to keep the humidity down to a comfortable level and one which is safe for the building and its contents.

The latter fact has caused trouble in electric heating installations in warm climates, such as in Florida and along the Gulf Coast. The same thing happens in most of our climates, although at different times of the year and for periods of shorter duration.

How many hours a year fall within various dewpoint temperature ranges? There is a different answer for each climate. For illustration, the record for a represenative year for the relatively cold climate of Madison, Wis., is shown in Table 3.

To combat the humidity and fresh air problems, a growing number of electric heating contractors are installing exhaust fans with humidistat control as a regular component of every heating job. They have found this to be an essential feature for customer satisfaction, and insurance against complaints. There are some instances where, in the very tight house desired for economy, use of the exhaust fan may fail to do the job in fairly mild weather, simply because there isn't sufficient crack area to permit air to leak in at the rate necessary to dry the inside air by dilution. The exhaust fan may draw a perceptible vacuum in the house and thus take in less fresh air then necessary to control humidity.

Conclusions

We are closing our eyes to the physical facts that exist during a material part of the heating season when we expect natural infiltration to care for either fresh-air requirements or the removal of water vapor. The cure for one difficulty will cure the other, most of the time. Natural infiltration varies from a sufficient rate at the design condition down to almost none in mild quiet weather. The occupants are forced into the nuisance of opening and closing windows, with resulting uncontrolled rates of fresh air intake. The minimum acceptable corrective action is the above-mentioned exhaust fan with reliable humidistat control.

Some twenty years ago it was discovered that our automobiles were more comfortably heated when pressurized with heated air. Cold air did not then leak in around the cracks and cause discomfort. We can and should do the same thing with our homes: build them as tightly as we know how, and provide positive, continuous intake and tempering of fresh air at the rate desired for comfort and economy. The basic rate of intake may be 80 cfm, perhaps as low as 40 cfm. A 2-speed or 3-speed intake fan can give the higher rates as needed for increased fresh air supply or increased atmospheric dehumidification. Where requirements exceed the capabilities of the intake fan, it may be supplemented by an exhaust fan. Air-exhaust outlets would be located in the kitchen and bathroom. Methods of providing automatic variations in exhaust apertures may be incorporated if required.

The fresh air taken in may be tempered to about room temperature by a duct heater of the proper size and delivered at a suitable location, such as by means of a baseboard diffuser in a hallway near the living room. Since duct-heater capacity costs less than and replaces in-space capacity, the saving partially offsets the extra cost of the fan, duct, and control. We need a manufactured unit including fan, heater and thermostat. When the demand becomes known, it will be provided. (For —15F design temperature and 80 cfm, for example, the duct heater required would be about 3000 watts.)

This still leaves unsolved the problem of dehumidification at outdoor dewpoints above 50F, and mechanical dehumidification appears to be the only answer. The requirement for an average home is a straight dehumidifier of about 1-hp size, with 2500 to 3000 Btu/hr latent removal capacity at say 75F and 55% RH entering air. It is an essential step toward the year-round electric climate-control goal.

Electric Heating Films

Electric Heating Goes to School; 18 minutes; full color; sound. Available on loan from Edwin L. Wiegand Co., 7500 Thomas Blvd., Pittsburgh 8, Pa.

Produced for the benefit of school board members, architects, consulting engineers, and school planning personnel. The story follows a typical suburban school board through its investigation leading to the choice of electric heat for a proposed new school.

How to Insulate for Electric Heating; 23 minutes; full color; sound-slide. Available on loan to contractor groups from Owens-Corning Fiberglas Corp., Toledo 1, Ohio.

Complete instructions for applying insulation to floors, walls, and ceilings, plus data on the principles of design and condensation.

All-Weather Comfort Standard

Proposed design heat losses and thermal performance factors for electrically heated and/or air-conditioned homes.

Table 1. Recommended Heat Loss Values

Degree Days	Design Heat Loss per sq ft of floor area	
	Btuh*	Watts
Over 8000	40	11.7
7001 to 8000	38	11.3
6001 to 7000	35	10.3
5001 to 6000	32	9.4
3001 to 5000	30	8.8
Under 3001	28	8.2

* Btuh is commonly used as an abbreviation for "Btu per hr."

Table 2. Thermal Performance Values

Building Section	U-Value† Btuh per deg TD
Ceiling	0.05
Frame walls	0.07
Masonry walls	0.12
Floors over vented spaces	0.07
Floors over unheated basements	0.09
Slab edge heat loss	30 Btuh per linear ft

† Calculated in accordance with the method described in current ASHRAE Guide, before correction for framing.

Table 3. Recommended Installed R-Numbers for Electric Heating and/or Air Conditioning*

Building Section	U-factor† (Btuh)	R-Number
Ceilings	.05	19
Frame walls	.07	11
Floors over vented crawl space	.07	13

* National Mineral Wool Assn.
† From All-Weather Comfort Standard.

THE commonly used 6-4-2 concept of insulating electrically heated houses has been criticized often as a "standard" because it refers to inches of insulation without regard to insulating performance, and its use presupposes that houses in all geographical areas profit equally by such insulation.

In an attempt to provide an improved industry standard for electrically heated and/or air-conditioned homes, a committee of interested personnel began work with a round-table meeting in April, 1959, out of which has emerged the "All-Weather Comfort Standard." Instead of recommending amounts of insulation, the Standard proposes maximum design heat losses based on geographical location (Table 1) and maximum heat-loss factors for various building sections (Table 2).

The entire Standard, including also recommendations regarding infiltration, ventilation, vapor barriers, and slab floors, was introduced at the First National Electric House Heating Symposium and Exposition in Chicago last March. Since it had no official sponsor, it was submitted to trade associations and electric utilities for study and possible voluntary adoption.

The values given are not meant to represent the "break-even" point between insulation costs and savings in operating costs. Proven better results are being achieved today. However, they do provide a yardstick by which the installer or designer can determine whether his projected installations are likely to provide reasonable "comfort and operating economy," as claimed in the Standard.

Values listed assume glass area to be no more than 15% as great as the floor area of the heated space. Where greater percentages exist, one or more of the given performance values must be bettered if the heat-loss figures of Table 1 are to be realized. Where construction prevents the realization of any of the U-values of Table 2, others may be reduced to make up the loss.

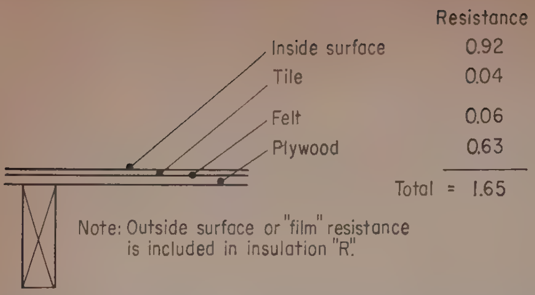
For example, design heat-loss calculations for a house insulated so as to attain the U-factors of Table 2 result in a heat loss exceeding the appropriate value of Table 1. A check of glass area shows it to be 20% as great as the floor area. Since all available wall space has been filled with insulation, more insulation should be added to the ceiling or floor or both to reduce heat loss in these areas until the value shown in Table 1 has been approximated.

R-Numbers

The new "R-numbers" adopted by the mineral-wool industry to describe insulating products were designed to facilitate compliance with the All-Weather Comfort Standard. The R-number indicates the thermal resistance of the insulation which, when the insulation is installed in standard frame ceilings, walls, and floors, will insure the U-factors specified in the Standard for these building sections.

Variations in finishing materials used for floors, walls, and ceilings (both inside and outside) will cause variations in the thermal resistance of the section; however, the resistance of the insulation is so much greater than that of the building materials that such slight variations may be neglected. The R-numbers are expressed as whole numbers.

Example: What is the thermal resistance of the insulation required to attain a U-value of 0.007 through a frame floor consisting of a ½-in. plywood subfloor plus ⅛-in. asphalt tile over the joists?


Resistance
Inside surface 0.92
Tile 0.04
Felt 0.06
Plywood 0.63
Total = 1.65
Note: Outside surface or "film" resistance is included in insulation "R".

Solution[1]: As shown in the sketch, the total thermal resistance of the floor between joists without insulation is 1.65. The resistance of a floor with a 0.07 U-factor is 1/.07 or 14.3. Therefore, the thermal resistance of the insulation required is the difference, 14.3 — 1.65, or 12.65. The R-value of the insulation would thus be 13.

For standard frame house construction, similar calculations give R-values for insulation in ceilings and walls, as shown in Table 3.

Thus, installing mineral-wool batts labeled R19, R11, and R13 in ceilings, walls, and floors, respectively, insures U-factors of 0.05, 0.07, and 0.07 Btuh per sq ft per deg F in these sections.

While the All-Weather Comfort Standard has been proposed only after much study and consideration of all factors involved, it is to be expected that field experience will ultimately point the direction and extent of improvement if such are needed.

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[1] See "Calculating Heat-Loss Factors" in Electric Heating Forum No. 2, *Electrical Construction and Maintenance*, August, 1960.

Electric Heating Equipment Sales, 1959

THE data presented in these three tables were obtained from a survey of all known manufacturers of electric heating equipment by the Building Materials Division of the Business and Defense Services Administration, U. S. Dept. of Commerce.

The annual volume of space heating equipment manufactured for habitable structures was reported as approximately $387 million:

Source of Heat	*Percent of Total*
Gas	46
Oil	42
Electricity	7
Solid fuel	5

Table 1. Output and Dollar Value* of Shipments

Type	Heating Output (Btuh x 1000)	Total Value	Percent of total value
Baseboard (not including glass panels)	9,571,986	$8,325,587	29.9
Convectors			
Without fan	1,618,280	5,596,254	20.1
With fan	1,138,839	4,250,219	15.3
Glass panels			
Baseboard	590,819	660,936	2.4
Radiant	234,101	1,432,897	5.1
Unit heaters and unit ventilators	666,601	5,654,322	20.3
Warm air furnaces			
Central	54,660	88,828	0.3
Floor	21,807	51,701	0.2
Wall	66,760	210,522	0.8
Cable systems, fabricated as			
Units	589,239	1,095,607	3.9
Cable only	85,520	467,421	1.7
Total	14,638,612	$27,834,294	100.0

Source: Dept. of Commerce (BDSA)
* As reported by 58 manufacturers.

Table 2. Shipments in Units

Type	Number of Units
Baseboard	2,269,880 lineal feet
Convectors	
Without fan	330,395
With fan	152,650
Unit heaters and unit ventilators	171,842
Warm air furnaces: central, floor, and wall	9,482
Cable systems (fabricated as room units)	123,324

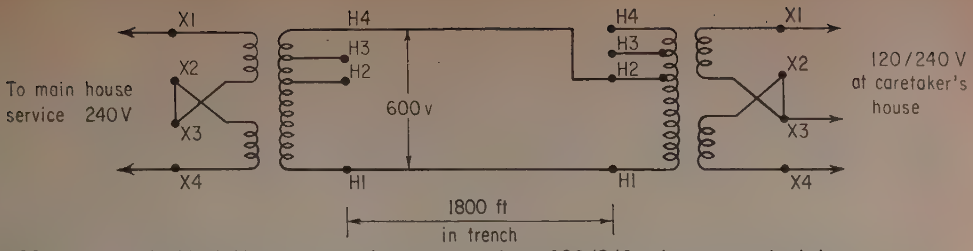
Source: Dept. of Commerce (BDSA)

Table 3. Distribution by Destination of Shipments

Census geographic division	Shipments	
	Value	Percent
New England	$1,209,725	4.3
Middle Atlantic	2,595,842	9.3
East North Central	4,208,720	15.1
West North Central	2,354,100	8.5
South Atlantic	2,892,600	10.4
East South Central	3,705,907	13.3
West South Central	1,382,117	5.0
Mountain	916,472	3.3
Pacific	5,961,755	21.4
Exports	82,921	0.3
Destination of shipments not available because of method of distribution of six manufacturers	2,524,135	9.1
Total	$27,834,294	100.0

Source: Dept of Commerce (BDSA).

Of the manufacturers contacted, 13 who did not manufacture electric heating equipment in 1959 stated that production was contemplated in 1960 or soon thereafter.



600-VOLT TRANSMISSION saved over $2600 in supplying 120/240 volts to caretaker's house.

A little extra

Small-Job Engineering

shows that the obvious way is not always the best way to do the job.

By **William C. Miller, P.E.,** *Consulting Engineer, New York City*

SOMETIMES a relatively small amount of study can result in a large amount of money cut from a job. What is frequently needed is a separate approach to each problem. Too often we find that methods are used more from familiarity than from the demands of the job. Simple fundamental principles applied in each instance pay off.

The contractor on the job proposed a 3-conductor 1/0 VCL cable to handle the current required at a reasonable voltage drop. This material would cost approximately $1800 per 100 ft, totaling about $3240—a frightening figure.

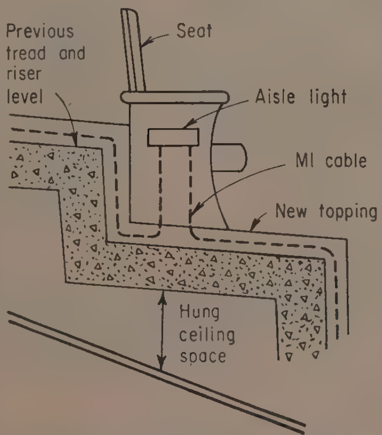
Since standard cable is insulated at 600 volts, why not look into the possibility of using it fully? We investigated transformers. An air-cooled, 600/120-240 volt transformer with two 5% taps on the high side and rated at 10 kva would cost $217. This quickly showed we were on the right track. We next considered cable size. We found we could take a 10% voltage drop in the 600-volt line and still deliver the same voltage as at the source. Taking another 3% as a reasonable reduction in available voltage at full load, we had a total of 13% which could be dropped in the line. This then was 78 volts against the 7.2 volts we could reasonably drop in the 240-volt line.

For a load of 10 kva at 600 volts, the line would have to carry a current of approximately 17 amps. For a 78-volt drop at this length and this current with cable buried in the earth, a No. 10 wire is suitable. We can buy single-conductor No. 10 Type USE or Type UF direct-burial cable for approximately $42 per 100 ft. Total costs are then

Transformers	$434.00
Cable	151.00

or a total of approximately $600.

The power lost in transmission is about 1000 watts higher at full load using the higher voltage drop. At an average demand then, the loss would be an additional 300 watts at a cost of about $10 per year. This extra expense in operating cost appears justified when it is balanced against approximately $150 a year in interest on the added investment in cable which transmission at the lower voltage would require. For approximately one hour's worth of study, the result to our client was a potential saving of $2640! Of course, the results here are more spectacular than can usually be expected; but a simple voltage study can often result in a substantial saving.



MI CABLE shaped to follow contour of theatre floor made chopping of existing floor unnecessary.

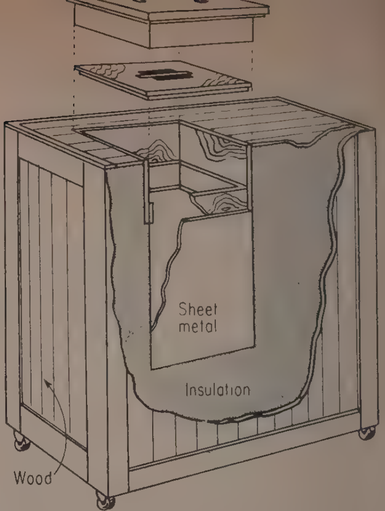
On another job we were presented with the problem of supplying a proposed air conditioning system on the 20th through 26th floors of an existing building. The cost of feeder cables and their installation appeared to be the single largest expense for electrical equipment. In this case we found that, by specifying a 750-kva transformer to bring the entering 120/208-volt 3-phase current up to 440 volts, considerable savings resulted. Not only did we save on copper and conduit, but we saved considerable wall-chopping and patching, inconvenience, labor, and switch costs.

Let us cite one further example. In a theatre alteration the aisle lights on the balcony seats were to be wired. The architect had specified a new topping on the steps. Rather than cut the existing floor and run conduit in the hung ceiling below, we studied the condition at the floor level. We concluded that by using mineral insulated (MI) cable we could easily have the cables formed to the new risers and treads and yet remain below the new topping. Here again the percentage savings were significant. Our arithmetic shows us that if we save 20 to 50% on enough parts of a job, we may finish with a 20% saving.

Deep-Freeze Unit For Depressed Temperature Tests

How to build an economical, practical deep freeze unit for small shop or laboratory use.

By Nelson Risch, *Norwood Works, Allis-Chalmers Mfg. Co., Norwood, Ohio*



CUT-AWAY SKETCH of unit showing details of interior construction.

WITH the growing demands on the special services of the small laboratory and workshop, a full complement of tools and equipment is a necessity. Many pieces of equipment incorporating precise control and instrumentation are being called upon to operate under extreme temperatures. Testing under these conditions is essential to guarantee satisfactory field operation. Hence, a deep-freeze unit can be a valuable addition to laboratory or shop facilities.

The unit described below can be built at a reasonable cost with easily available materials. It will hold temperature down to −72°C for an indefinite period of time.

Material items for this unit include the following:

One-inch thick boards (free from knots)
Waterproof paper
Cold temperature insulation
Moisture-proof insulating paper
25-gage galvanized iron
Thermometer (suitable range)
Coolant for refrigeration
Cabinet handles
Casters

The completed wood box is lined with waterproof paper. Cold temperature insulation is then added. Four-inch thick Styrofoam boards prove very satisfactory. The insulation should be moisture-proofed with waterproof paper or an epoxy resin and must be at least 8 in. thick.

When the insulation is in place, a sheet-metal container with a wood molding around the top is then inserted in the center of the box. Another layer of waterproof paper is placed on top of the insulation and the box top nailed in place.

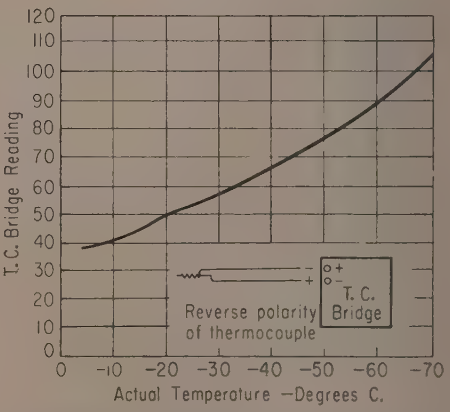
Two lids are recommended for the well above the container. The inner lid is a piece of plywood with a recessed wooden handle and tube-type insulator nailed around the outer edge. The outer—or top—lid is insulated with 4 in. of insulation board; is protected with a sheet-metal cover; is outlined with a tube-type insulator; has cabinet-type handles. The addition of casters adds mobility to the freezer.

Since the deep-freeze unit has no forced-air circulation, a wet bath is necessary for steady-state temperature testing of samples. Isopropyl alcohol, 98/100% pure, is used for the wet bath for an accurate means of measuring temperatures. If the wet bath is not desired, a copper constantan thermocouple may be used with a thermocouple bridge, with the thermocouple polarity reversed.

COMMON FREEZING BATH MIXTURES

MIXTURE	TEMPERATURE CHANGE—DEGREES C FROM	TO
Common Salt (NaCl), 1 part; Snow, 3 parts	0	−17.7
Common Salt (NaCl), 1 part, Snow, 1 part	0	−18.0
Calcium Chloride ($CaCl_2$), 3 parts; Snow, 2 parts	0	−32.7
Calcium Chloride ($CaCl_2$), 2 parts, Snow, 1 part	0	−42.2
Sal Ammoniac (NH_4Cl), 5 parts; Saltpeter (KNO_3), 5 parts; Water, 16 parts	10.0	−12.2
Sal Ammoniac (NH_4Cl), 1 part; Saltpeter (KNO_3), 1 part; Water, 1 part	7.7	−23.8
Ammonium Nitrate (NH_4NO_3), 1 part	10.0	−16.1
Potassium Hydroxide (KOH), 4 parts; Snow, 3 parts	0	−37.2

NOTE: Dry Ice (carbon dioxide highly compressed and in a solid state) can be used as a refrigerant for freezing above mixtures of from −40°C to −72°C, or used to obtain temperatures.



REFERENCE GRAPH showing correlation between thermocouple bridge readings and actual temperature inside cabinet.

IN ELECTRICAL WIRE & CABLE . . . THE SPARK OF QUALITY IS KAISER WIRE EXPERIENCE
KAISER WIRE

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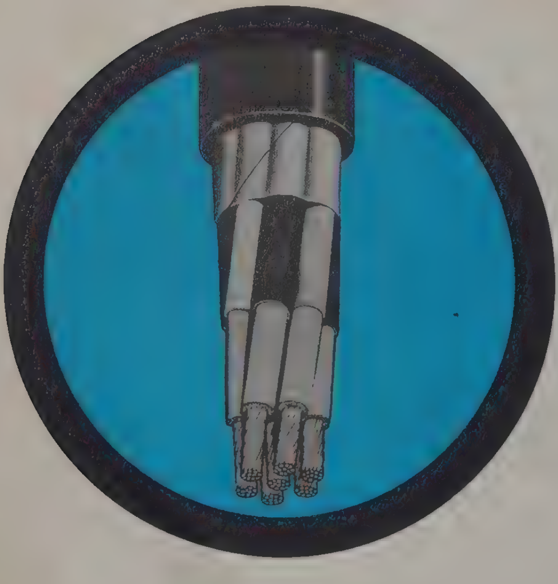
Laytex-Resin is the combination of Laytex insulation with a specially-compounded resin layer over the insulation that eliminates the bulk of braided coverings. It brings the following advantages over extruded constructions:

Smaller diameter, to expand service without enlarging ducts...less weight...increased flexibility...proven greater insulation protection against acids, alkalies, flame, fungus, water, oil, ozone and light...uniform protection free of thin spots...can't wick moisture or fray...easier splicing...brighter color coding and longer lengths per reel.

SPECIFY 935-S. ASK FOR KAISER CONTROL CABLE BOOKLET.



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KAISER GRIZZLY® POWER CABLE is the only power cable to resist 6000 hours of high ozone shock test—outlasting 9 leading brands tested!

Several samples of each unshielded 5KV cable were placed with a "U" bend resting on a grounded metal plate. A conductor-to-plate potential of 40,000 volts was applied until all cables failed. Four brands failed immediately. The last competitor gave out 432 hours before the first Kaiser cable. Kaiser Grizzly samples went on to last over 6000 hours . . . 16.4 times longer than the test average of best performances . . . 2.4 times the life of the nearest competitor.

The reason: A superior combination of Kaiser insulation and jacketing. In power cables it represents a major victory over the main cause of failure—dielectric breakdown due to ozone.

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PORTABLE CORD... NEARLY THREE TIMES AS MUCH SERVICE

KAISER MASTER LAYTEX® PORTABLE CORD is tested and proven to give nearly three times the service, on the average, of cords of equal price. A saving of two-thirds in actual cord costs on the job!

This superiority came from Kaiser research into all causes of portable cord failure—more than 12,000 individual tests comparing more than 1000 cords of all makes.

The results: Patented K/W portable cord with a lead-cured 60% Neoprene jacket surpassing ASTM D-752 requirements from 15% to 100%... rayon fillers for overall resistance to pull... fibrous core inside the conductors to absorb strain, increase flexibility... conductors perfectly centered in grainless Kaiser Laytex insulation which has three times the strength of milled natural rubber.

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Isolated Electrical System For Missile Base

Self-sufficient deisel-engine generators furnish all power needs through 4160-volt switchgear.

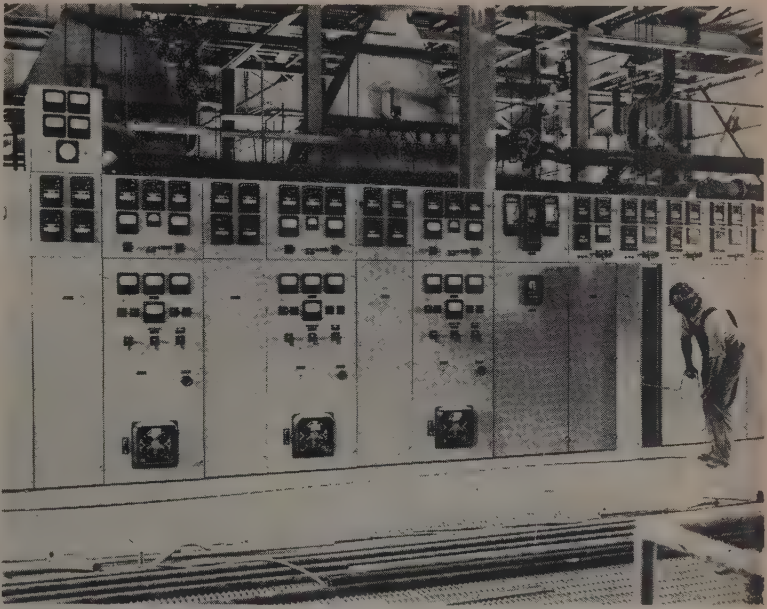
A COMPLEX electrical installation distributes, controls and protects vital power for the new Bomarc missile site at Dow Air Force Base, Bangor, Maine. Equipment includes high- and low-voltage circuit-breaker switchgear, power transformers, lighting panels, distribution and power panels and motor control centers.

The electrical power system at the site is completely self-sufficient. Power, supplied by three diesel-engine generators, feeds directly to 4160-volt indoor switchgear—consisting of 13 frames with three generator circuits and five feeder circuits. From this switchgear, power feeds to three low-voltage substations—two outdoor and one indoor-outdoor—equipped with 3-phase hookups of single-phase, 333-kva transformers which step down voltages from 4160 to 480 volts. A total of ten oil-insulated, self-cooled transformers are used in this installation.

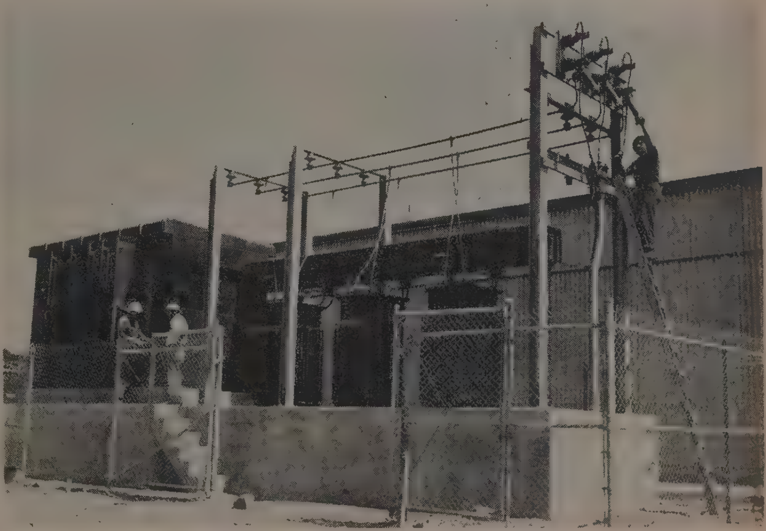
The substations provide economy and flexibility. They incorporate low-voltage power breakers and molded-case CBs for feeder protection. The steel structures used at each outdoor substation were designed and built specifically for this installation to provide for rapid, convenient interchange of the single-phase transformers for maintenance and service.

The Dow installation has 28 missile launchers, each housed in 60-ft-long reinforced concrete buildings. Each building has a special roof consisting of two sections which slide apart when the missile is elevated for firing. The 47-ft missile is capable of speeds up to about Mach 3 and has a range of 250 miles. It is controlled by a radar-computer system which obtains altitude, speed and heading information and converts it into control signals which guide the Bomarc to intercept hostile aircraft.

The U.S. Army Engineer Division, New England, Corps of Engineers, was the construction agency for USAF. The electrical contractor was J. Livingston Company, Boston, Mass. Architect-Engineers for the project were Fay, Spofford and Thorndike, Boston, Mass., and A. J. Harriman, Auburn, Maine.



4160-VOLT SWITCHGEAR in powerhouse at missile base provides control and protection for circuits from three generators and outgoing feeder circuits to load-center substations.



OUTDOOR SUBSTATION is fed from generators in the powerhouse through conduit terminated in pothead at right. Three 333-kva single-phase transformers are connected for 4160-480 volt stepdown. Construction of the concrete base, the steel structure and the fence provide for fast and effective interchange of transformer units for maintenance or fault replacement.

NEW HI-VOLTAGE CABLES
FROM THE
BRONCO STABLES

BRONCO
Certified 66
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portable
3KV & 5KV

To its string of tough, high-spirited, Bronco blue-ribbon champions Western Wire now adds hi-voltage cables bearing the proud brand BRONCO 66 CERTIFIED. The outer protecting jacket is certified to contain not less than 67.32% neoprene—highest content in the industry! And now—on the inside—BRONCO 66 Hi-Voltage cables are insulated with BRONCO XL BUTYL. This double-barreled protection assures you championship performance . . . a neoprene hide with maximum resistance to ozone, sunlight, oil, abrasion . . . a heart of butyl, dielectrically strong, amazingly resistant to high temperatures, corona, and aging. A big plus value is Bronco's patented branding; complete identification is repeated at precise two-foot intervals on the jacket—vulcanized in so it won't rub off. Bronco 66 Certified Hi-Voltage types W, G, and SH (shielded types A, B, C, and D) are now available immediately to users through Electrical Wholesale Distributors. They're champing at the bit, raring to go to work for you. When you invest in a big cable for the long haul, call for the service champ—BRONCO 66 CERTIFIED! Enjoy the long-term economy of top quality.

Write for a complete description of portable Hi-Voltage Bronco 66 Certified. Also ask for data on our duct and direct burial hi-voltage items.

WESTERN

WESTERN INSULATED WIRE COMPANY
Los Angeles 58, California

Hydraulic-Lift Crane Speeds Overhead Work

A fast finish is applied to light poles on Illinois' East-West Tollway by a hydraulic-lift crane, with aerial basket attached. Two men—truck driver and high-riding maintenance man—put the finishing touches on these 30-ft poles at the rate of 24 per day, to wind up the job for Premier Electric Company, electrical contractors of Chicago, Ill. The contract called for complete installation and preliminary maintenance of 460 lighting units.

Premier Electric uses its versatile lift for a variety of jobs, including installation of signs and other electrical facilities for commercial and government needs. The mobile unit is also used to handle poles, transformers and other equipment with speed and safety. Both men and tools can be put aloft in seconds for quick work on overhead jobs. The hydraulic swinging boom permits inch-close positioning. And the self-unloading truck can be used to haul materials and equipment.

HYDRAULIC-LIFT CRANE has aerial basket for mechanic permitting a comfortable work position for servicing of high-mounted equipment. Just two of the electrical contractor's men put finishing paint touches on 24 poles in one day

Low-Voltage Switching Plus Dimmers for Residential Lighting

Lighting control using low-voltage relays and transformer-type dimmers adds to the convenience of modern living in the two-story home of Mr. and Mrs. Jack Podell in Pleasantville, N. Y.

Seven 8-position Remcon master switch units at entrances and in

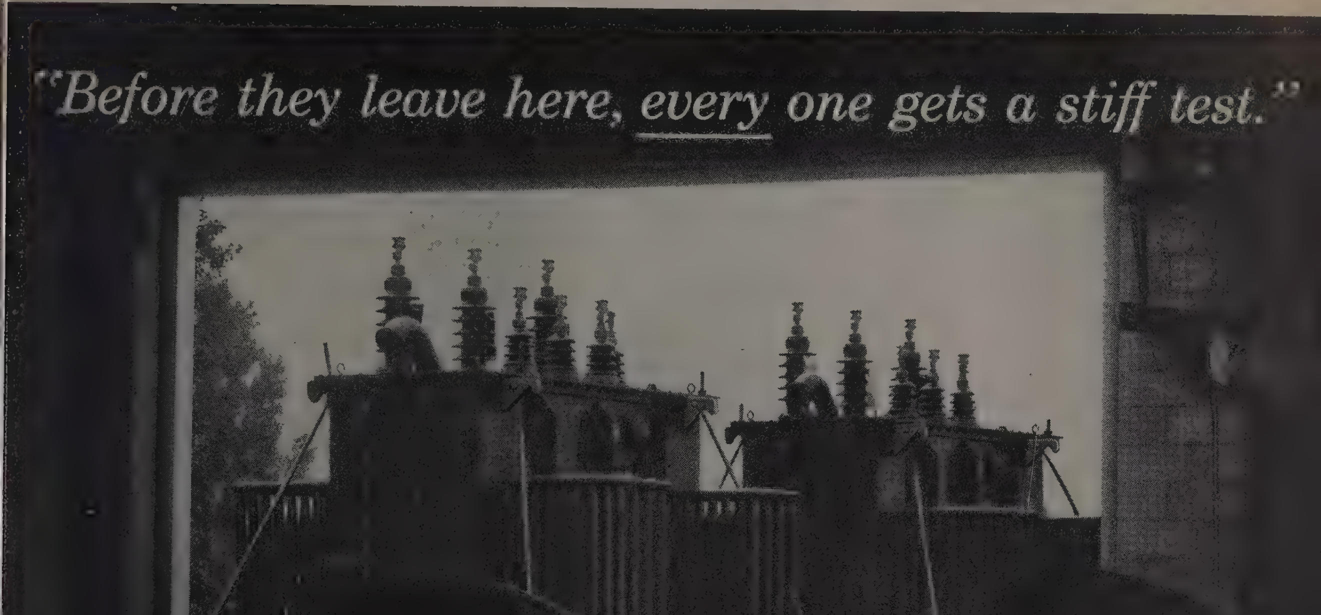
NIAGARA

TRANSFORMERS

"No exceptions. Not a single Niagara Transformer reaches the shipping platform without being thoroughly tested."

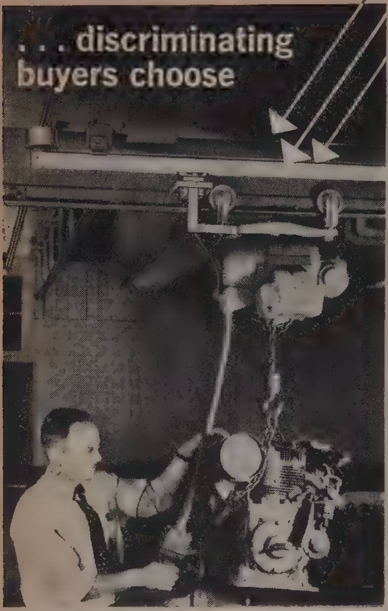
At Niagara, product quality is watched all along the line... starting with raw materials. To win an "ok" for shipment, completed transformers must pass rigid performance tests. Not only do they conform to NEMA and ASA standards, but in many ways exceed them.

Designed with liberal overload capacity, Niagara Transformers are produced for practically every service through 10,000 kva, 69,000 volts. Write for Bulletin 139. Niagara Transformer Corp., P.O. Box 23, Buffalo 25, N. Y. Representatives in principal cities.


"Before they leave here, every one gets a stiff test."

INERT GAS SEALED DRY TYP

GOOD REASONS WHY...



FEEDRAIL
Crane and Hoist Electrification

The right choice of an electrical system for cranes and hoists is reflected in increased operating efficiency and lower costs. In addition to unfailing power, you need the safety to equipment and personnel given by steel enclosures. You need compactness and adaptability, a flexibility to meet electrical requirements of tomorrow as well as today. And you need a system low in installation cost, easy to maintain during the life of the crane or hoist.

That's why thousands of companies have selected FEEDRAIL Crane and Hoist Electrification Systems with the movable trolley outlets that travel right along with the crane or hoist.

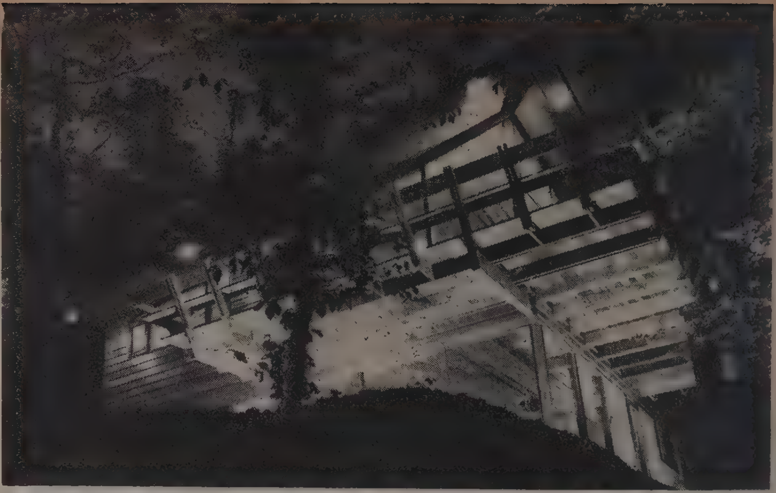
Why not get the details about FEEDRAIL today?

For safety, adaptability and convenience electrify with . . .

FEEDRAIL®
TROLLEY BUSWAYS

FEEDRAIL CORPORATION
DEPT. C-5, 125 Barclay St., New York 7, N. Y.
Please send Bulletin No. 76 "Feedrail Crane and Hoist Electrification Systems"

Name ____ Title ____
Firm ____
Address ____
City ____ Zone ____ State ____



EXTERIOR LIGHTING, including recessed incandescent eave fixtures over balcony terrace and floods positioned on balcony framing members, is controlled both from terrace entrance and from master bedroom by 6-volt switches.

LIVING-DINING AREA lighting includes 70 running feet of shielded fluorescent strip at junction of wall and ceiling and recessed incandescent fixtures in ceiling around two sides of center firelapce. Dimmers and low-voltage switches are visible above counter top at right. Blank section adjacent to fluorescent strip at upper right houses low-voltage relays.

SKYLIGHTS furnish natural light to passageway from main entrance to living room on upper floor. A single 40-watt fluorescent lamp in each plastic diffuser converts skylights to luminaires after dark.

master bedroom plus 2-, 3-, and 4-switch units throughout the remaining rooms provide multi-point control of all lighting on both levels, eliminating many needless steps. Luxtrol dimmers in living room and downstairs playroom circuits permit control of lighting intensity in these areas to suit the activity.

Attractively situated on hilly terrain, the house is highlighted at night by fixtures recessed into the eaves above the cantilevered terrace, by floodlights mounted on the underside of the balcony, and by the spill of interior light through the glass walls of the living room.

Electrical work was done by the Aucello Electric Corp., Thornwood, N. Y.

Phase Identification on 3-Phase Ungrounded Circuits

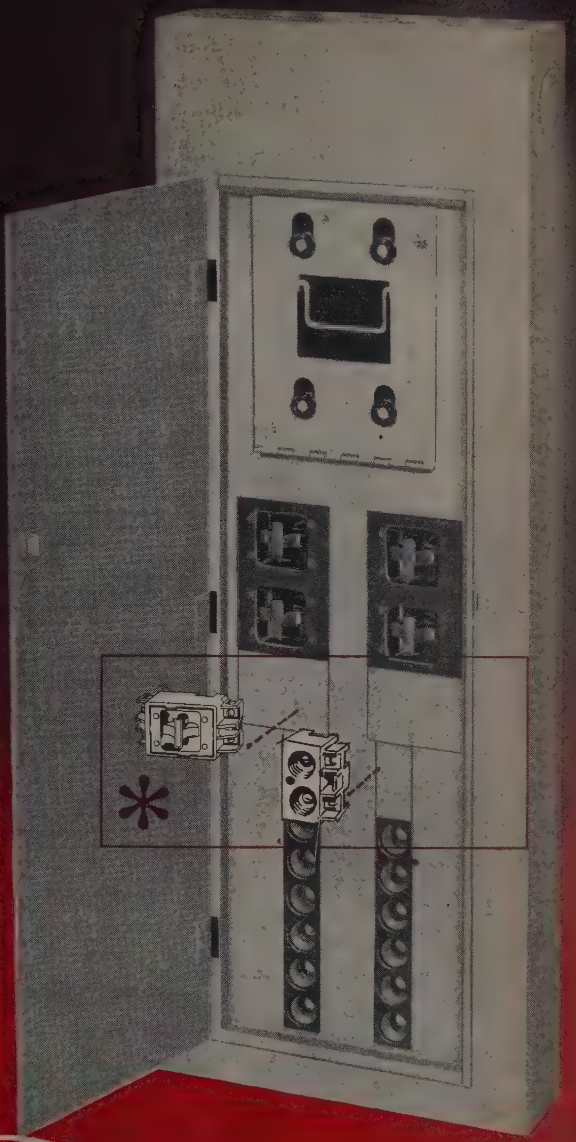
An industrial plant maintenance electrician was faced with the problem of identifying specific phase conductors of a 440-volt, 3-phase, ungrounded distribution system at two distantly separated parts of the plant. The conductors had no identifying tags or color coding. The following is the test procedure he developed.

At the time of the test, all phases were clear to ground, except for a capacity voltage of about 300 volts. His first step was to connect four 100-watt, 110-volt lamps in series between one phase conductor and ground where the circuit originated at the entrance switchgear busbars. This artificially grounded

NEW!

200-AMP ADD-ON* SERVICE Equipment

HINGED MAIN PULLOUT!



ARROW AH HART

FLEXIBLE and VERSATILE... All 200-amp "Add-On" pullout and branch circuit units are interchangeable with A-H 100-amp "Add-On" units. Now you meet any customer's 200 amp electrical needs—present *or* future—with just one unit. This unit comes factory-assembled with a main 200-amp pullout, four 30- or 60-amp pullouts and twelve fused branch circuits . . . and you can add 1 or 2 pullouts and 2 or 4 branch circuits at any time with a maximum of 6 pullouts and 16 branch circuits. Exclusive hinged main pullout for convenience.

COMPACT ENCLOSURES... smaller than other comparable units, save space and make faster installations. The 14⅜″ width allows mounting between studs.

FAST, EASY INSTALLATION... is insured by extra wiring space throughout the enclosure . . . including full 5″ head space for incoming service lines. Ample knockouts are located adjacent to the branch circuits. Neutral terminal bars will accept wire sizes 4 to 14.

GET ALL THE FACTS. Write today for complete information. Department ECM, The Arrow-Hart & Hegeman Electric Company, 103 Hawthorn St. Hartford 6, Conn.

ARROW AH HART

Quality since 1890

ENCLOSED SWITCHES • WIRING DEVICES

NOW

. . . a complete line of
OIL TIGHT PUSH BUTTONS
and PILOT DEVICES

FEATURING EXCLUSIVE
"TURN-TO-TEST"
ILLUMINATED
PUSH BUTTON!

1. *TURN* BUTTON TO TEST LAMP FOR FAILURE.
2. PILOT LIGHTS IF LAMP IS OPERATIVE.
3. *PUSH* BUTTON TO START, WITH FULL ASSURANCE PILOT WILL GIVE A TRUE INDICATION!

Satisfy Every Control Need . . . with this complete line that includes: Standard, Mushroom, Extended, Metal and Lock-Type Buttons; Pilot Lights; Standard and Lock-Type 2- and 3-Position Selector Switches; and variations, modifications and accessories to meet individual needs.

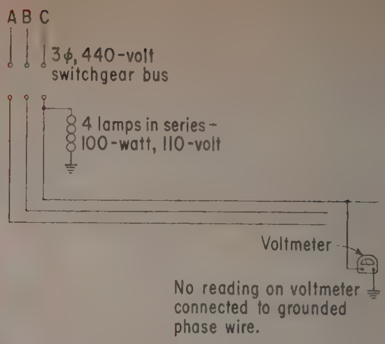
Meet Highest Performance Standards . . . push button and pilot devices all interchangeably mounted, are sturdily constructed from quality materials and deliver long life and dependable operation on the toughest, heavy-duty industrial applications.

Write today for complete information on these A-H Oil Tight Push Buttons . . . and also on our standard Duty and Heavy Duty Push Button Lines. The Arrow-Hart & Hegeman Electric Company, Dept. ECM, 103 Hawthorn St., Hartford 6, Conn.

ARROW AH HART
Quality since 1890

MOTOR CONTROLS • ENCLOSED SWITCHES
APPLIANCE SWITCHES • WIRING DEVICES

ARROW AH HART


A B C
3φ, 440-volt switchgear bus
4 lamps in series - 100-watt, 110-volt
Voltmeter
No reading on voltmeter connected to grounded phase wire.

IDENTIFYING PHASES OF 3φ UNGROUNDED CIRCUIT

TEST METHOD used to phase-out unidentified conductors of a sprawling 3-phase, 440-volt, ungrounded distribution system.

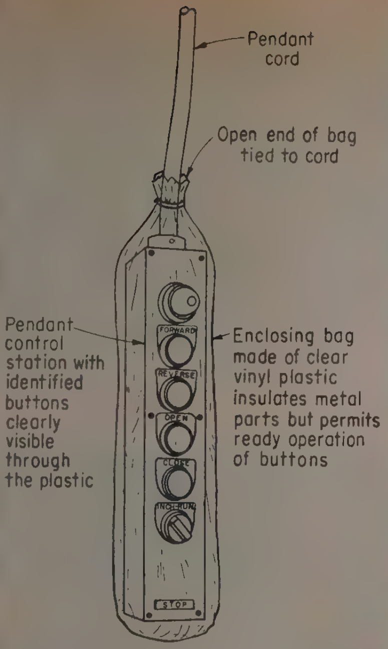
this phase throughout the plant. A voltmeter connected between this conductor and ground anywhere in the plant would give little or no reading. The lamps did not light up. At predetermined check points, this conducter (showing no reading) could be permanently tagged Phase C (see diagram) or otherwise coded to correspond to phase identification at the switchgear.

The same procedure was repeated on each of the other two conductors of the circuit with each conductor being tagged as tested for phase identification.

Plastic Jacket Waterproofs Switch

Chemical plants, breweries, plating works, and laundries are locations that are prone to develop trouble from moisture infiltration and corrosion to the electrical equipment installed. A frequent source of shocks to operating personnel in such locations is the common pendant switch station used with overhead cranes, boom cranes and fixed electric hoists. Even the best of switches used with rubber grommets about each control button and a ground wire attached to the switch frame can develop hazardous leakage current. The use of rubber gloves has proved an effective device against shock hazard; but their use is often neglected and the cause of the trouble is then not eliminated.

The solution to the hazard problem is to keep such switches dry. This can be achieved by cutting a sheet of 2-mil thick clear vinyl plastic to size, then sealing off the bottom to form a bag, and slipping this bag over the pendant switch assembly. The open end may be


Pendant cord
Open end of bag tied to cord
Pendant control station with identified buttons clearly visible through the plastic
Enclosing bag made of clear vinyl plastic insulates metal parts but permits ready operation of buttons
FORWARD
REVERSE
OPEN
CLOSE
INCH-RUN
STOP

TYPICAL PENDANT SWITCH enclosed in a clear plastic bag to shield the assembly against moisture, dust and fumes—eliminating shock hazard and protecting the unit against malfunction due to corrosion or the presence of foreign material. The clear plastic permits ready identification of the various pushbuttons.

secured by several means such as waxed cord, tinned copper wire, or even strips of vinyl tied around the throat of the bag. The transparent plastic permits identifying the designations on the several buttons mounted in the switching sequence and serves to keep everything securely dry and free from corrosive fumes and moisture.

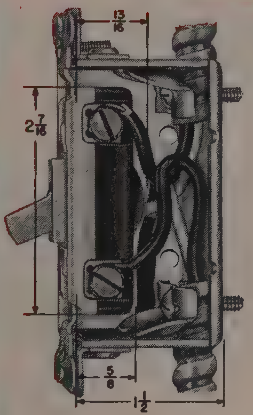
One method of keeping corrosion destruction down to a minimum in control cabinets is to use electric heat developed through small heater elements or the use of old style carbon lamps located where needed to prevent accumulation of moisture.

Special Vault for 33,000-Volt Substation In Industrial Plant

A new 33,000-volt electrical substation is now in operation at the Collegeville, Pa., plant of Superior Tube Company. The inside location permits future expansion of the physical plant in any direction without moving the substation to make room for new construction. The new electrical substation, which is located in the basement of Superior's large mill, doubles the

ARROW AH HART

Because of THIN-WALL CONSTRUCTION you asked for this NEW
ARROW-HART
SPACE SAVER Quiette
SWITCH



H&H
SPECIFICATION GRADE
UL
No. 1101
15 amp.
120-277 volts, ac only

This comment is typical of many received upon the introduction of Arrow-Hart's exclusive SPACE-SAVER Quiette Switch. Here's why . . .

"This has been needed for a long time... space-wise as well as price-wise!"

EXTREMELY SHALLOW BASE . . .
only 5/8" from face to back. FITS 1¼" BOX.

GREATER WIRING ROOM . . .
making wiring easier, faster.

TWO WIRE ANCHOR HOLES . . .
at each binding screw for holding wire when looping around binding screw.

BIG BINDING SCREWS . . .
with deep-cut slots, for gripping wire firmly, assuring permanent holding and strong, positive connections.

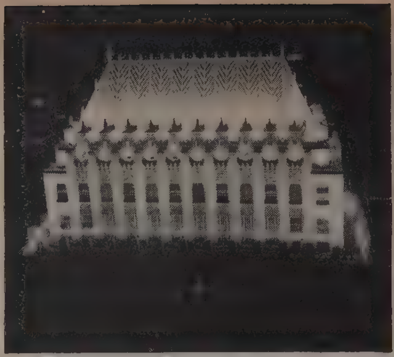
QUIET, MECHANICAL ACTION

AVAILABLE IN BROWN OR IVORYLITE

FOR FULL INFORMATION . . . on the new Arrow-Hart Space-Saver Quiette Switch and the complete line of Arrow-Hart Quiette Switches, write to Dept ECM, The Arrow-Hart & Hegeman Electric Co., 103 Hawthorn St., Hartford 6, Conn.

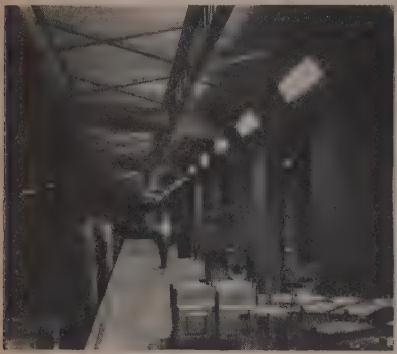
ARROW AH HART
Quality since 1890
WIRING DEVICES • ENCLOSED SWITCHES
APPLIANCE SWITCHES • MOTOR CONTROLS

PERIMETER LIGHTING helps prevent trespassing and costly pilfering.



ARCHITECTURAL LIGHTING will add prestige and beauty to buildings.

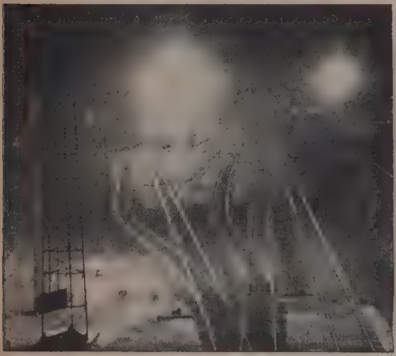
SHOPPING CENTERS boost nighttime business when brightly lighted.



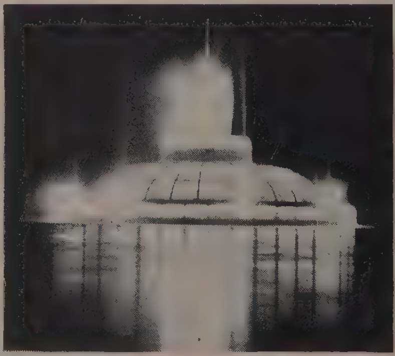
LOADING DOCKS become safer, more efficient when properly lighted.

FACADE LIGHTING gives safety, identification to building and store fronts.

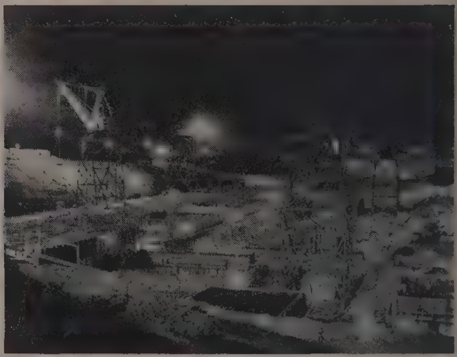
GRAND COULEE DAM lighted by 742 General Electric 1500-watt floodlights.



RAILROAD YARD lighting cuts accidents, thefts and costly freight damage.

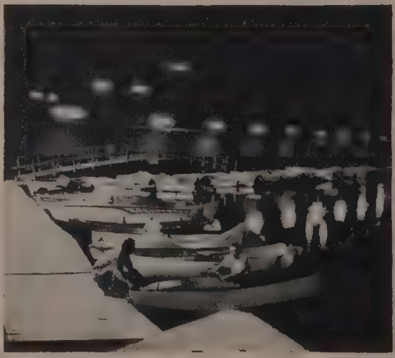


FOUNTAINS assume day-time beauty with brilliant, multi-colored floodlights.

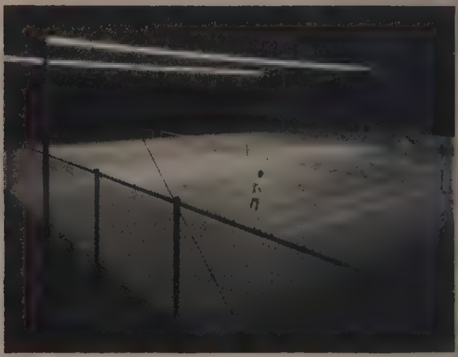


NIGHT CONSTRUCTION is safer and more practical with floodlighting.

ATHLETIC FIELD lighting lengthens the time available for fun and play.



DOCK FACILITIES nighttime usage is greatly increased with floodlights.



TENNIS COURTS attain round-the-clock use with modern floodlighting.

When light means more safety, fun, beauty, or efficiency, General Electric floodlights will do it best—at least cost

STORAGE YARDS can be just as accessible at night as they are by day.

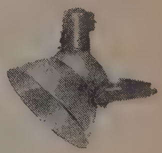
PLANT ENTRANCES need modern lighting to facilitate visitor checking.

GUIDE SIGN lighting adds convenience, safety to highway travel.

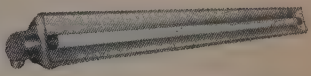
AIRPORTS become safer, and more convenient with proper floodlighting.

As floodlights in these 16 areas are switched on there is an immediate addition of beauty, safety, efficiency. Nighttime crowds fill the lighted recreational areas; movement of raw materials and finished goods is speeded on lighted loading docks; a fountain with multi-colored lights becomes a nighttime landmark.

These are typical results of proper outdoor lighting. The benefits are many—the applications unlimited. But, regardless of the job to be done—from Grand Coulee Dam to highway guide signs, from Milwaukee's County Stadium to railroad yards—General Electric has experience to do the job best . . . and a full line of floodlights to do it at least cost:



FILAMENT OR MERCURY LIGHTING is simple with any of General Electric's L-69A (high efficiency), L-80 (heavy-duty enclosed), or L-55 (economy open-type) units. Each of these floodlights features G.E.'s exclusive "diamond back" reflector . . . designed to deliver from 5% to 35% more light . . . and distribute it more uniformly.



FLUORESCENT LIGHTING units are available in 4-, 6-, and 8-foot lengths. Two housings are offered—one for G.E.'s High Output lamps—the other for G.E.'s Power Groove lamps.

Here's an added benefit—over 500 conveniently located distributors are ready to supply General Electric floodlights and technical aid for your installation. Call your nearest distributor—ask for General Electric's *new* Floodlighting bulletin with descriptions, application information, and product data on the complete line. G-E Easy Lighting Layouts are also available for most floodlighting applications. Use the coupon below if you don't know the distributor in your area.

Progress Is Our Most Important Product

GENERAL ELECTRIC

General Electric Company, Section C460-04, Schenectady 5, N. Y.

Please send me free floodlighting information as indicated below:

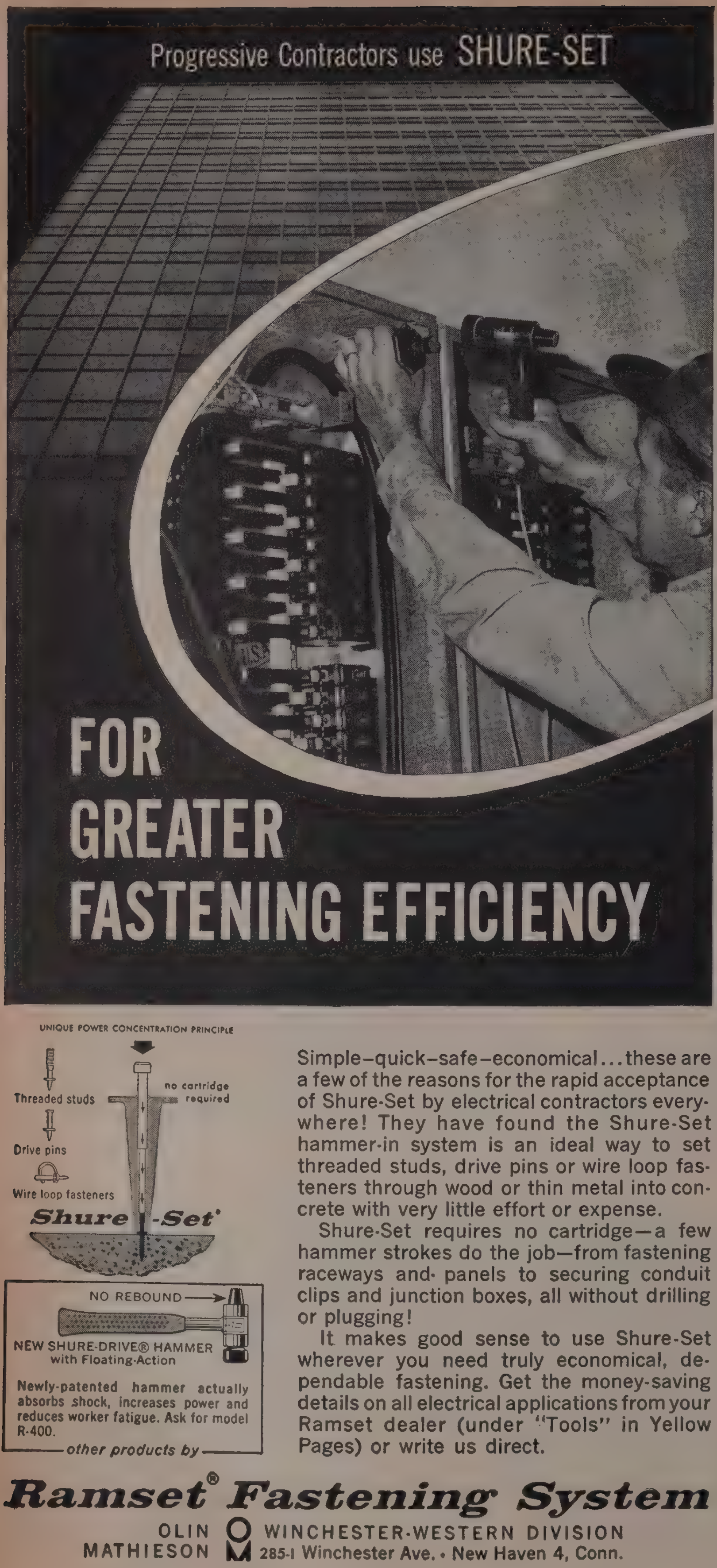
☐ **Floodlighting—Bulletin GEA-7201**

☐ **Easy Lighting Layout for** ______ **Application**

Name ______

Street ______

City ______ **State** ______


Progressive Contractors use SHURE-SET
FOR GREATER FASTENING EFFICIENCY
UNIQUE POWER CONCENTRATION PRINCIPLE
Threaded studs
no cartridge required
Drive pins
Wire loop fasteners
Shure-Set
NO REBOUND
NEW SHURE-DRIVE® HAMMER with Floating-Action

Simple–quick–safe–economical...these are a few of the reasons for the rapid acceptance of Shure-Set by electrical contractors everywhere! They have found the Shure-Set hammer-in system is an ideal way to set threaded studs, drive pins or wire loop fasteners through wood or thin metal into concrete with very little effort or expense.

Shure-Set requires no cartridge—a few hammer strokes do the job—from fastening raceways and panels to securing conduit clips and junction boxes, all without drilling or plugging!

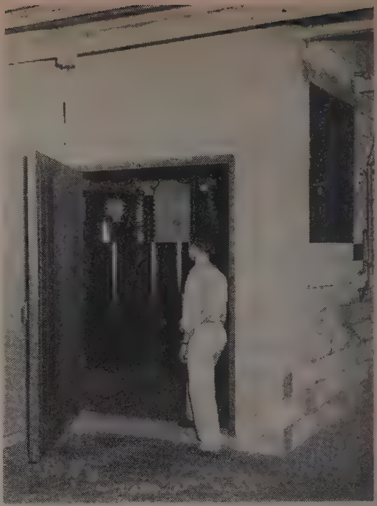
It makes good sense to use Shure-Set wherever you need truly economical, dependable fastening. Get the money-saving details on all electrical applications from your Ramset dealer (under "Tools" in Yellow Pages) or write us direct.

Newly-patented hammer actually absorbs shock, increases power and reduces worker fatigue. Ask for model R-400.

other products by

Ramset® Fastening System

OLIN MATHIESON
WINCHESTER-WESTERN DIVISION
285-I Winchester Ave. • New Haven 4, Conn.



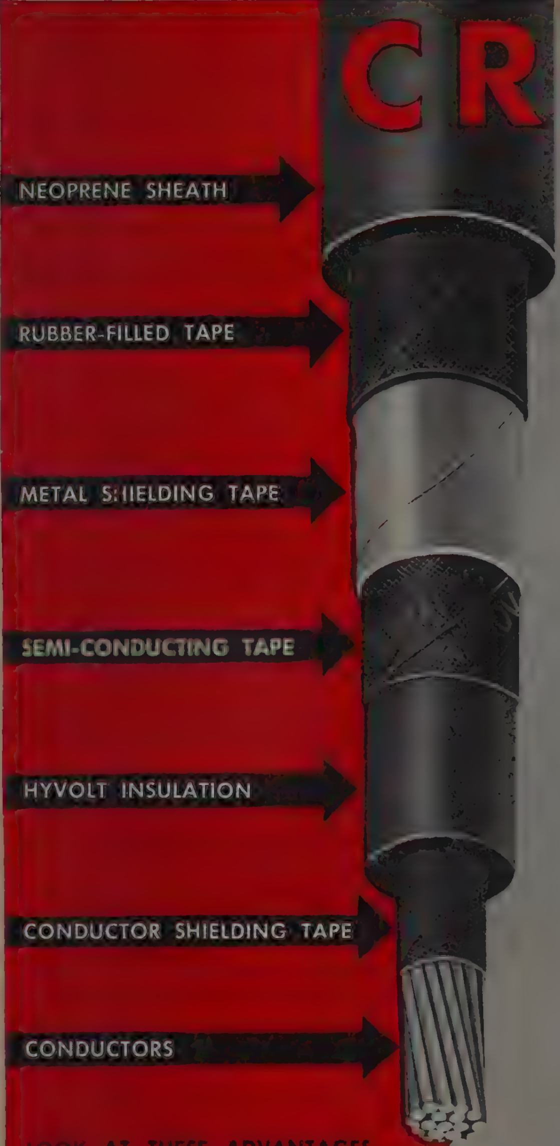
CONCRETE-BLOCK VAULT houses three transformers for 33,000-volt indoor substation. Air for effective ventilation is drawn through the grilled opening in the vault wall, at right. The air passes over the transformers, carrying heat out through an opening in the opposite wall. If fire should start in the vault, metal slots inside the grilled opening close automatically and cut off the air supply to the fire.

500-KVA TRANSFORMERS in 33-kv vault are liquid-cooled units, set as shown. The National Electrical Code requires use of a vault for any transformer —oil-filled, askarel-filled or dry type— when the unit operates at more than 15,000 volts. Central location of the vault facilitates expansion of the plant in any direction from this load center.

plant's transformer capacity. Both it and Superior's first substation, located outdoors on the west side of the plant, have three 500-kva transformers. The new substation has an indoor ACB drawout-type switchgear to distribute power to various parts of the plant.

Installing the substation indoors required special safety measures. The wires from the 33,000-volt primary line were sheathed in lead and brought underground into the basement location. Ewald and Miller Consulting Engineers did the de-

CRESCENT



HYVOLT SHIELDED POWER CABLE

Gives More Amperes Per Dollar of Installed Cost

CRESCENT HYVOLT insulation is made from butyl rubber which is inherently resistant to ozone, heat, moisture and aging. HYVOLT is formulated and processed so as to retain these inherent characteristics of the butyl rubber and at the same time provide excellent electrical and physical properties.

The insulation is protected during and after installation by an outer neoprene sheath providing a maximum degree of toughness, durability and long life. It is flame retarding and resistant to the deteriorating effects of moisture, sunlight, ozone (corona), oil, grease, and many acids and alkalies.

HYVOLT Shielding provides additional internal and external protection in these THREE WAYS

1 Conductor shielding, as provided by a semi-conducting tape over the stranded conductors, excludes air pockets between conductor and insulation and eliminates possible internal corona-cutting of the insulation.

2 The semi-conducting tape between the insulation and metallic shielding tape prevents possible ionization of air spaces and corona at the insulation surface.

3 The metallic shielding tape is grounded when installed, resulting in zero potential to ground at the sheath. It prevents surface discharge or burning, and protects cable from lightning surges. Reduces shock hazard.

RECOMMENDATIONS

CRESCENT SHIELDED HYVOLT CABLE is recommended for use in conduits, underground ducts, in wet or dry locations, or buried directly in the ground, for circuits operated at over 3000 volts and in accordance with I.P.C.E.A. recommendations. Available in single conductor or multi-conductor cables.

Specify CRESCENT SHIELDED HYVOLT POWER CABLE for general power circuits and where severe conditions are prevalent such as chemical plants, refineries, paper mills, mines, sewage disposal plants, etc. It is approved as Airport Lighting Cable Type B, CAA Specification L-824.

LOOK AT THESE ADVANTAGES

1. Long life.
2. Can be operated at 85°C. Permits smaller conductors or more amperes per conductor.
3. Freedom from corona cutting.
4. Excellent resistance to moisture.
5. Low power factor and dielectric loss.
6. Lighter, more flexible, easier to handle and install than lead covered cables.
7. Electrolytic or chemical corrosion of lead sheath is eliminated by use of neoprene sheath.
8. Shielding prevents possibility of surface burning and provides safety to human life.

CRESCENT INSULATED WIRE & CABLE CO., INC.

TRENTON, NEW JERSEY

Photo courtesy of Western Electric Co.
Architects & Engineers: Lockwood Greene

This is **PRACTICAL MAINTENANCE . . .** WITH *Servisafe* POLES

In less than 10 minutes, this man will have finished replacing a burn-out and cleaning a luminaire. It's a fast, efficient, no sweat job. He is free from climbing hazards, and the lowered fixture is dead. In addition, his only "auxiliary" equipment is a detachable handline!

The unique advantages of Thompson "Servisafe" Metal Poles assure year-round all-weather lighting maintenance at minimum cost. In fact, there is no easier, safer or more economical method of servicing pole-mounted luminaires.

FOR DETAILS AND PRICES, WRITE FOR BULLETIN PWB-59.

8314-TE

THE THOMPSON ELECTRIC CO.
P. O. BOX 873-D • CLEVELAND 22, OHIO

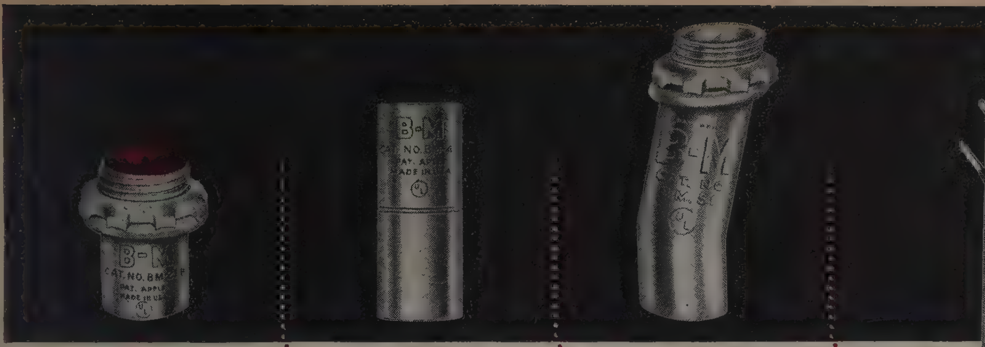
sign work on the new substation. Philadelphia Electric Company provided technical assistance to the local electrical contractor—J. F. Davis of Valley Forge, Pa.—in making the underground cable installation. The most difficult problem was to provide ventilation to cool the transformers while making provisions to contain and put out transformer fires should they occur.

Superior's engineering department designed and built a special concrete-block vault to house the three transformers. Cooling air flows into the vault through a screened opening in one wall, over the transformers and through a duct opening in the opposite wall and then to the roof. For fire protection, heavy metal slats, resembling a Venetian blind, are installed inside the opening through which the air enters. They are held open with a chain, one link of which is made from metal with a low melting point. If fire breaks out, the link instantly melts, and the metal slats close to seal off the opening. With the air supply cut off the fire quickly dies out. The new substation installation has been approved both by the Philadelphia Electric Company and the Factory Mutual Fire Insurance Companies.

Correction

On page 114 of the August issue a sketch showing the use of a clamp type ammeter to locate conductors in a trough is in error. The method is effective only when one circuit conductor is included in the group checked. No reading would be obtained if both conductors of the circuit were enclosed in the meter clamp as shown. To avoid this possibility the trough might be used as the grounded conductor of the test circuit. Thanks to J. V. De Armond of South Gate, Calif., who called this to our attention.

MAKING CONNECTIONS for contractors Wismer & Becker of Sacramento, Calif., are electricians Friedrick Woehr and Ray White, here pictured at a sprinkler and fire alarm panel located in the new $6-million Sheraton hotel in Portland, Ore.



Red Throat
BM-21B
½" Connector
BM-22B
¾" Connector
BM-23B
1" Connector

BM-41
½" Coupling
BM-42
¾" Coupling
BM-43
1" Coupling

BM-51
½" Offset Connector
BM-52
¾" Offset Connector

BM Offset
Connectors
showing how
wires are
guided over
box edge.

SAVE IN SIXTY

Save time and money with

B-M ORIGINAL INDENTER FITTINGS

Here is the combination that is unbeatable when it comes to easier E.M.T. installation at less cost. New lightweight plier size indenters make setting up thin wall conduit a breeze. B-M fittings are neater too! No unsightly nuts or projecting set screws.

A few more of the plus features of B-M fittings are Concrete tight—Vibration resistant—Extra heavy bright zinc plate, salt spray and acid drip tested for corrosion resistance—Extra heavy positive bonding locknuts—smooth rounded edges or bushed throat type connectors that prevent insulation damage—All steel construction with extra heavy gauge wall thickness.

ALL BRIEGEL FITTINGS ARE U. L. APPROVED AS CONCRETE-TIGHT

When setting E.M.T. in concrete you can make each job easier and more profitable by using Briegel All Steel Indenter Fittings that have UL approval as Concrete-Tight. Contractors everywhere recognize their cost cutting qualities and the fact that they make each wiring job a better job. It is only natural that Briegel Fittings are the most widely used E.M.T. connectors and couplings.

BM PLIER SIZE INDENTERS
BM—No. 607 ½"
BM—No. 608 ¾"
BM—No. 609 1"

UL — Underwriters' Laboratories, Inc. — Re-Examination Service

TELESCOPE BM SYSTEM

All B-M indenter type fittings far exceed the requirements of U. L. file card E 10863 and Federal Specifications W-F-406.

BRIEGEL METHOD TOOL CO.
GALVA • ILLINOIS

USED THE MOST FROM COAST TO COAST

Introducing the elegant . . . slim, trim

BENJAMIN CORONADO

new design distinction in commercial lighting

Now . . . Benjamin introduces the ultimate in dramatic fluorescent lighting—the slim trim Coronado. It's excitingly different, with the smart, slender look of distinction. Available in either a clear or "Prisopal"® lens, the Coronado hugs the ceiling in perfect harmony of design, with a visible depth of only 2½". Its distinctive styling sets this unit apart from all other plastic enclosed units.

The Coronado leads the field in practicality, too. *One-piece diffusing element . . . finger-touch latch . . . built-in coupler . . . snap-in wiring channel*—all add up to the easiest installation and maintenance ever. The Coronado combines beauty with new features and dollar savings in a way that assures complete satisfaction, whether used for appearance or price.

Available in 2 or 4 lamp—40 W. Rapid Start

EXCLUSIVE NEW FEATURES

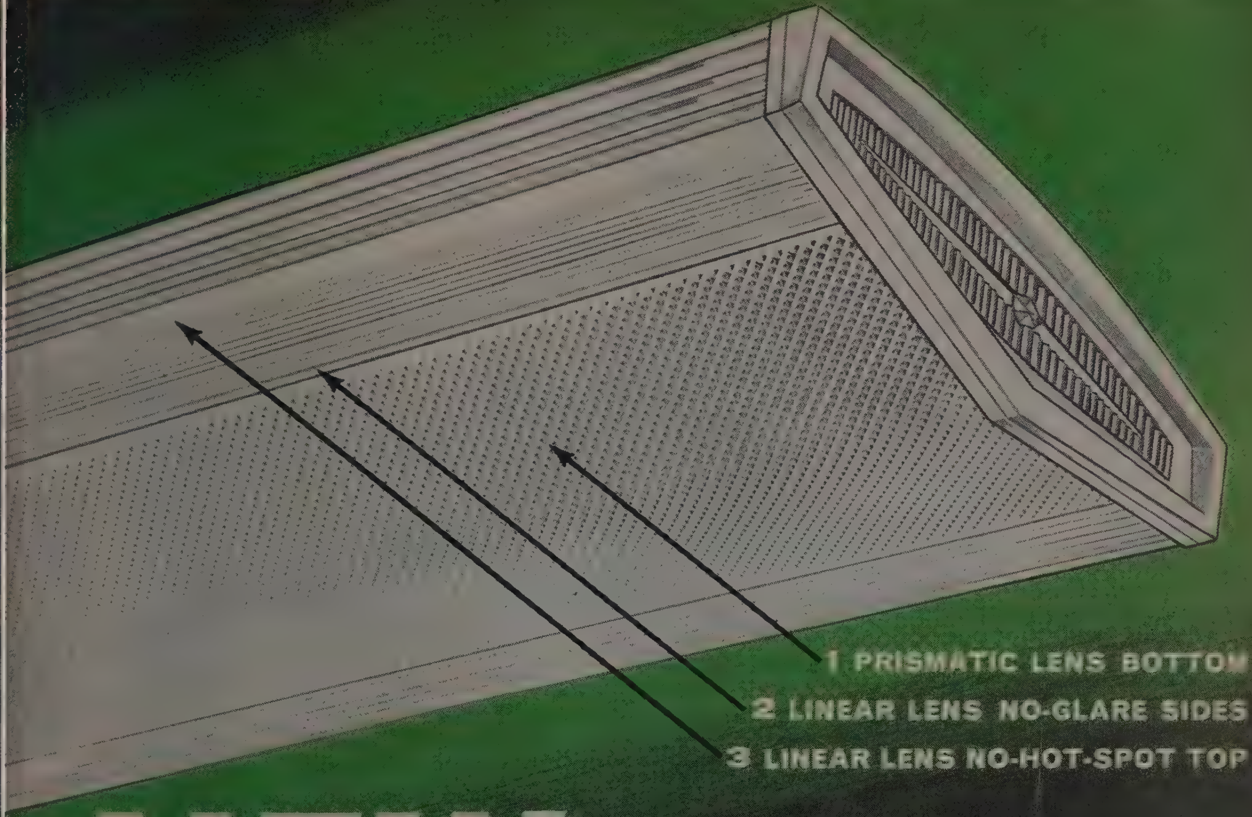
NEW . . . finger-touch latch hinges from either side, allows basket to swing down or be removed—no tools needed.

NEW . . . snap-in wire way cover provides easy access to wiring and control equipment.

NEW . . . end plate design permits easiest tandem installation, coupling units in perfect alignment.

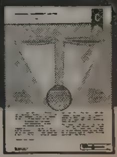
NEW . . . decorative plastic end caps available for use on individual units or at ends of row.

NEW . . . one-piece "wrap-around" extruded plastic construction—only 2½" visible depth.



NEW

3-in-1
light diffuser in a
surface mounted unit

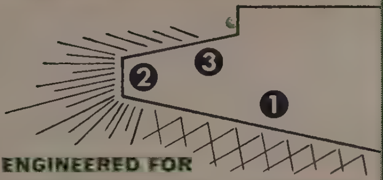


CORONADO—CLEAR LENS (Top)

This new 3-in-1 diffuser boasts a crystal-clear L-120 low-brightness prismatic bottom, complemented by linear refracting lenses on sides and top to redirect light out of glare zone. Here is the ultimate in clear, color-stabilized polystyrene.

CORONADO—PRISOPAL® LENS (Bottom)

With the addition of opalescent white, this totally new 3-in-1 diffuser becomes a beautiful diffusing surface offering something new in controlled illumination.



ENGINEERED FOR CONTROLLED LIGHT DIFFUSION

1 Low-brightness L-120 prismatic lens on bottom for superior performance and control.

2 Refracting linear lens on sides redirects light out of the glare zone, effectively controls side brightness.

3 Refracting linear lens on top increases efficiency, spreads light uniformly over ceiling, banishes "hot spots."

For full information on the new Benjamin Coronado, mail coupon to Benjamin Division Thomas Industries Inc., 207 East Broadway, Louisville 2, Ky., Dept. BECM-9

BENJAMIN
DIVISION
THOMAS INDUSTRIES INC.
The World's Largest Single Source of Lighting for Commerce, Industry and Home.

Send FREE copy of Coronado Folder to:

COMPANY__________

ADDRESS__________

CITY______ZONE____STATE______

NAME__________

SORGEL'S SPECIALIZATION

assures Quiet Quality dry-type transformer performance that's the finest in the industry

Since 1916 the principal products at Sorgel Electric Company have been dry-type transformers. Because of this long-time pioneering, specialization and experienced engineering, Sorgel customers are assured of continuous, more dependable transformer performance.

The Quiet Quality of Sorgel dry-type transformers provide the highest efficiency, which reduces operating costs. Sorgel specialization assures a product that requires little or no maintenance, and a design that's easy, more economical to install.

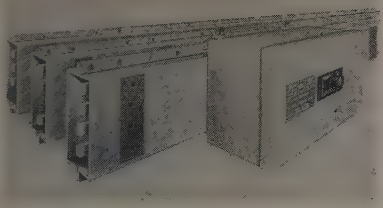
Imaginative progress has been, and is being, made every day at Sorgel. In all forms of modern electrical distribution the Sorgel product is your best buy in stepping down higher distribution voltage to utilization voltage for institutional, commercial and industrial buildings. Look for the Sorgel mark, and when you find it, you'll know this electrical installation was the first choice of a quality-conscious Consulting Engineer, Plant Engineer, Contractor or End-user who wanted to assure dependable, uninterrupted electrical distribution.

Complete Line for Every Purpose up to 10,000 Kva, up to 15,000 Volts,
Including Special Transformers and Saturable Reactors

SORGEL ELECTRIC COMPANY

836 West National Ave., Milwaukee 4, Wisconsin

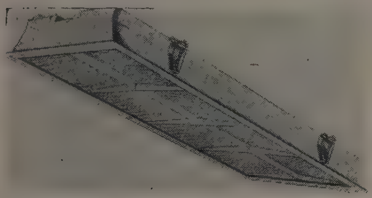
Sales engineers in principal cities. Consult the classified section of your telephone directory or communicate with our factory.



Busway (1)

A new packaged busway of 100-amp capacity, called "Speedbus," can be used wherever electric lighting and power are needed in commercial, institutional and industrial type buildings. Three- and 4-wire constructions are standard. A Speedbus system can be quickly relocated, rerouted or extended to meet any production line changes. It is made in pre-assembled sections of package 5- and 10-ft lengths ready to install, with 16 full-contact, polarized plug-in outlets in every 10-ft length. Outlets are spaced eight to each side of busway, back to back, and all 16 outlets can be used simultaneously. Eight plug-in outlets are incorporated into the 5-ft length.

National Electric Div., H. K. Porter Co., Inc., Porter Building, Pittsburgh, Pa.



Troffers (2)

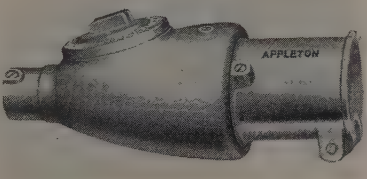
A new line of recessed fluorescent troffers called Shallow line, featuring a wide variety of diffusing elements and an overall depth of 4⅞ in. Troffers are designed to provide greater structural freedom between floors by allowing plenum depth to be reduced. Features include one-piece diffusing elements, up to 8 sq ft of glass, lens or louver. Troffers are available for all popular ceiling types. The 14 basic types of shielding elements include Benjamin L-120 lens, Corning No. 70, Holophane Prismalume, Owens-Corning Fiberglas, ½ in. by ½ in. Polystyrene or aluminum louvers, a new drop-dish acrylic panel and parabolic low brightness aluminum.

Benjamin Division, Thomas Industries Inc., 207 *E. Broadway, Louisville, Ky.*

Limit Switch (3)

A new, heavy-duty lever limit switch is designed for mill and general industrial applications to give improved service on cranes, hoists, industrial conveyors and elevators. It may be used also as a pilot-circuit device to limit travel or setup functions at pre-determined positions. Available for either 2- or 4-circuit operation, it features a smaller, lighter enclosure. A choice of general purpose, weatherproof, watertight, or dust-tight enclosures of NEMA Types 1, 3, 4 or 5. Switches may be either base- or side-wall mounted.

General Electric Co., Schenectady 5, *N. Y.*



Receptacle (4)

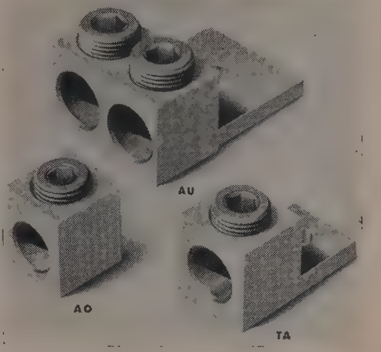
An all new pendant-type explosion-proof receptacle, known as "CPSHC," has been specifically designed for ceiling mounting. All arcing, if any, is confined within a plug combustion chamber of the dead-end receptacle. They have UL approval for Class I, Groups C and D. Receptacles have been designed for use with type "CPP" explosion-proof plugs. "CPSHC" pendant receptacles are made of polished aluminum. They have a ½-in. hub with set screw and are rated at 20 amps, 1 hp, 115 or 230 volts, 60 cycle, ac, single phase and 2-wire, 3-pole circuit.

Appleton Electric Co., 1701 *Wellington Ave., Chicago* 13, *Ill.*

Support Clamp (5)

Type S clamp supports periscope service pipes, hanging electric signs, etc. Fits 1¼-in., 1½-in. and 2-in. pipe. Clamp can be used with guy wires. Complete unit with ¾-in. pipe sockets and hinges designed for use with ¾-in. supporting pipe braces. Made from heavy-gauge steel and zinc galvanized.

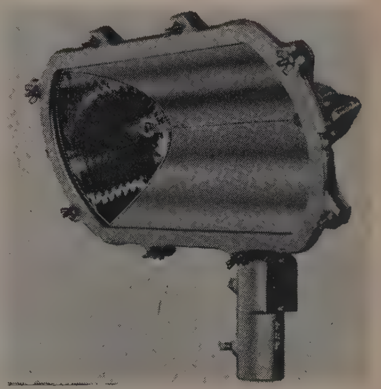
Ramco Manufacturing Co., 540 *Westfield Ave. W., Roselle Park, N. J.*



Connectors (6)

Complete lines of new aluminum connectors that include lugs for single and double cables up to 600 MCM; box style lugs up to 600 MCM; and switchgear lugs with two mounting holes up to 1500 MCM. Fabricated from high-strength 6061-T6 aluminum structural alloy, these lugs are electro-tin plated, assuring high tensile yield strength, resistance to corrosion and high electrical conductivity.

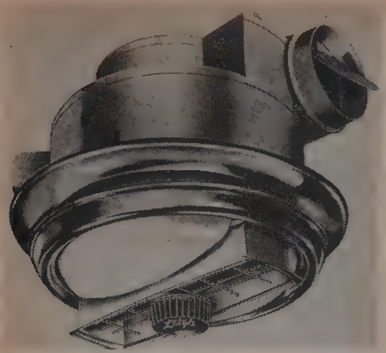
Ilsco Corp., 4730 *Madison Rd., Cincinnati* 27, *Ohio*



Floodlight (7)

A new floodlight with a vertical beam spread of 8° and horizontal beam spread of 100° is called Wide-Lite Lumitor. The quartz-iodine lamp life is rated at 2,000 hours. It has a mean efficiency of 22 lumens throughout its life. Applications for the Lumitor include decorative lighting of tall buildings from near the base of the wall and lighting for stadiums, golf driving ranges, signs, billboards, airport runways, and marine uses. Available in 500- and 1500-watt models. Both models mount on 1½-in. pipe masts.

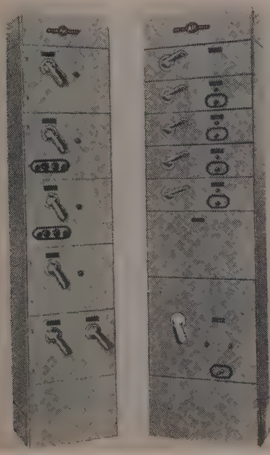
Wide-Lite Corporation, Box 191, *Houston, Texas*



Heat-Light-Fan Unit (8)

New combination heater, light, ventilating fan unit for use in bathrooms. Model 5412 includes a 3-way switch plate, completely prewired; made up of a polished aluminum control panel, three separate switches to actuate blower, light and heater; and a red pilot light tied in series to the heater and fan. Balanced lighting is provided by two lamp sockets. A 1320-watt, 4500-5000 Btu heating element has a built-in safety switch to prevent overheating. Unit is easily installed in any home, between standard joists. Literature is available.

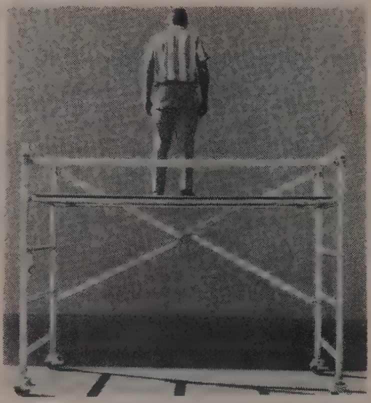
Leigh Building Products, Div. of Air Control Products, Inc., Coopersville, Mich.



Control Centers (9)

New Type "MC" motor control centers offer up to ten NEMA Size 1 control cells in a single vertical section 90 in. high. Centers will be supplied in two types differing in cubicle size. Type MC-5 will be for most general purpose industrial applications, provides up to 5 Size 1 control cells in a single cabinet 20 in. wide and 90 in. high. Type MC-10 provides up to 10 Size 1 cells in a cabinet 25 in. wide and 90 in. high and will be for commercial and institutional applications. Each control cell normally houses a combination starter unit. Included are: reversing, non-reversing, 2-speed, part-winding, and reduced voltage starters in NEMA Size 1 through 5, in combination with fuses or unfused disconnect switch or circuit breaker of thermal magnetic or instantaneous trip type.

Arrow-Hart & Hegeman Electric Co., Hartford, Conn.



Scaffold (10)

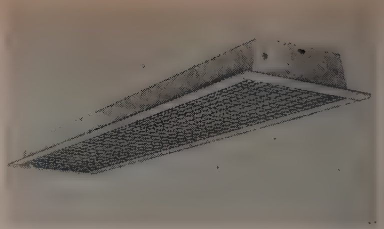
New one-piece aluminum scaffold on wheels unfolds in seconds. Two folding V braces snap together and lock automatically. The scaffold, 10 ft long and 29 in. wide, rolls through doorways and narrow aisles. Platform height is adjustable from 1 ft to 8½ ft. Casters lock automatically; legs are instantly adjustable for uneven floors and stairways. It is dimensionally interchangeable with standard Up-Right span type scaffolds.

Up-Right Scaffolds, 1013 *Pardee, Berkeley, Calif.*

Cable (11)

New plastic-jacketed non-metallic sheathed cable, called Thermo-Triex, has been announced. The individual conductors will continue to be insulated with a polyvinyl-chloride compound and color coded according to standard industry practice. The outer covering will also consist of a special polyvinyl-chloride compound which is designed not to deteriorate. This new outer covering for non-metallic sheathed cable is resistant to flame, impact, oil, alkalis and acids. It is free stripping, bright and smooth.

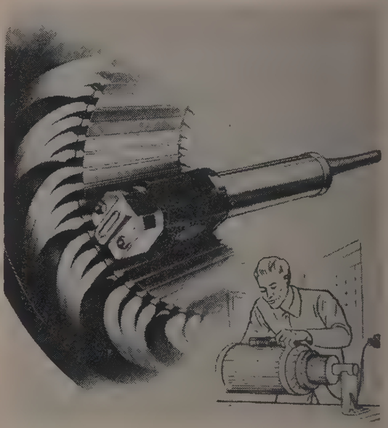
Triangle Conduit & Cable Co., Inc., Triangle and Jersey Aves., New Brunswick, N. J.



Troffer (12)

A redesigned troffer line, known as the Aurora Compact, is 3½ in. in depth and features a thin socket plate mounted on end panel. It is available in 1 by 4 and 2 by 4 rapid start units for lay-in or flange-type installations. Choice of four diffusers: aluminum or plastic eggcrate, inverted hexagonal, prismatic "Starlite" lens, or the new polystyrene diffuser.

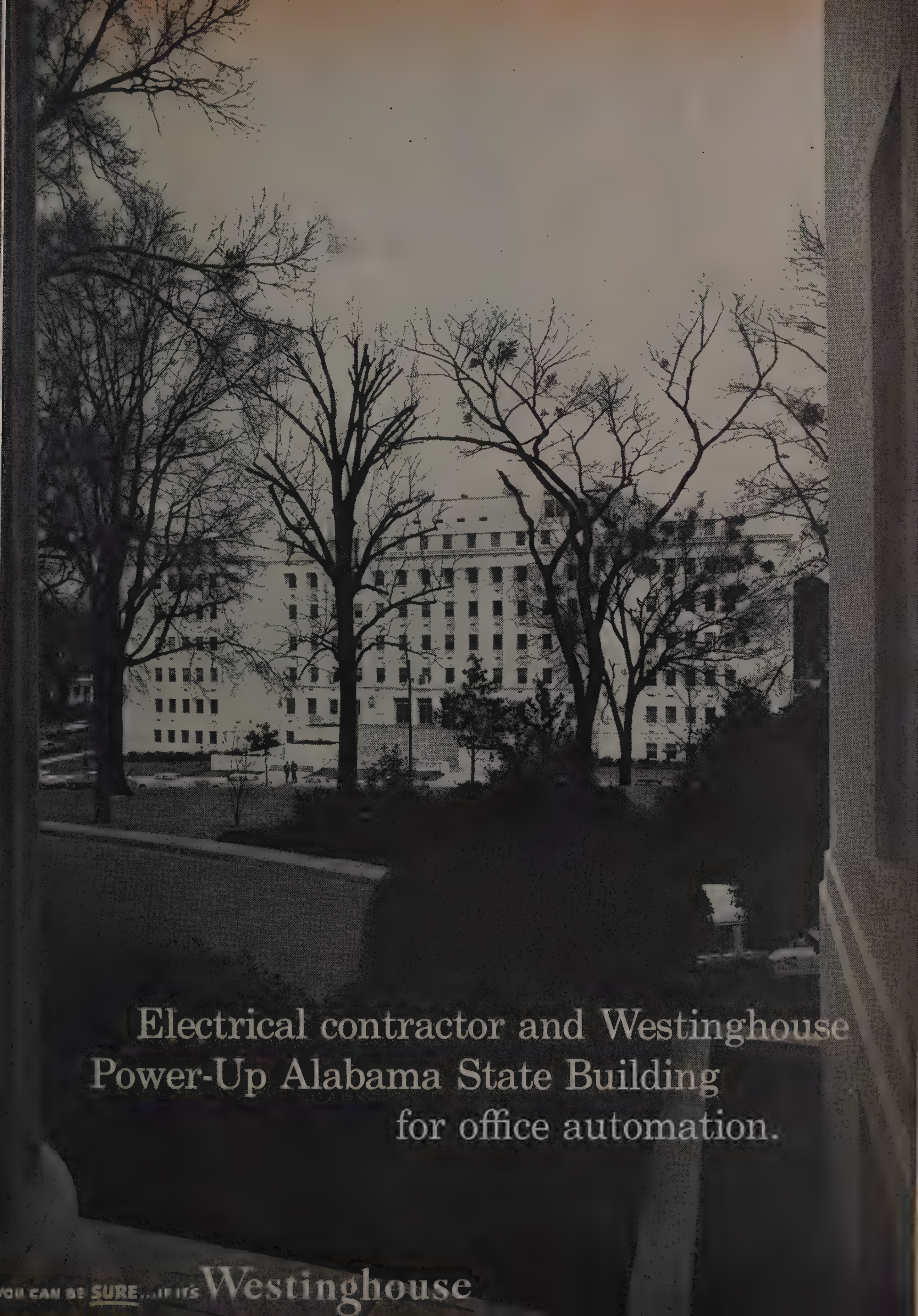
Metalcraft Products Co., Inc., 6225 *State Road, Philadelphia* 35, *Pa.*



Motor Tester (13)

A new electric hand tester provides quick and sensitive indication of faults in motor stators and rotors. The unit is used to check winding slots and employs an indicator lamp to reveal faults. Sensitivity with this lamp is much greater than it could be with an audible signal. Unit will readily indicate the short-circuiting of a single turn in a winding, and its strong inductance provides reliable testing of the largest motors. Operating on ac or dc, from 105 up to 240 volts, this tester checks single-phase and 3-phase rotors and stators for shorts, checks slip rings for shorts, and checks dc armatures for winding and commutator faults, for wrong connections, and for opens.

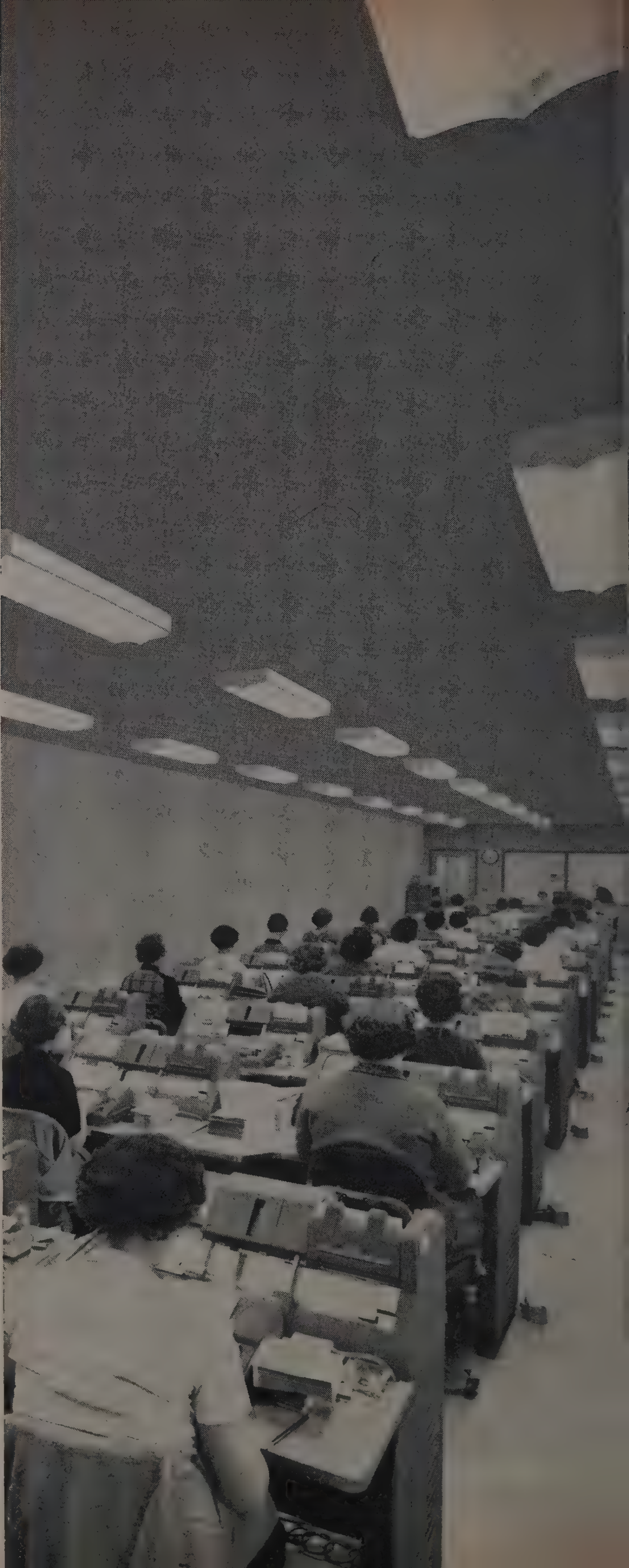
August Schoenenberg Inc., 1267 *W. Laurelton Pkwy, West Englewood, N. J.*


Electrical contractor and Westinghouse Power-Up Alabama State Building for office automation.
OU CAN BE SURE...IF IT'S Westinghouse

COVER PHOTO

Newest facade on Alabama's Capitol Hill is the seven-story, 258,500-square-foot State Administration Building shown on cover. The building houses 17 state agencies, will eventually be the "working home" for more than 1100 Alabamians.

New State Administration Building is geared for latest "office automation" techniques like data processing area *(at right)* which handles a steady flow of facts and figures. Westinghouse Type SC fluorescent luminaires, ceiling mounted for fast installation, provide an attractive and cheerful work area for state employes.



Teamwork paid off for the new Alabama State Administration Building. Careful evaluation of all building functions, sound planning and careful coordination produced a modern electrical distribution system—installed on time—that's ready to meet all present demands, anticipates future needs. Tandy Little, Jr. *(center)*, partner T. D. Little Electric Co., reviews specifications with O. E. Hatcher, Westinghouse Area Sales Manager; H. D. Mosley, Mosley and Yarbrough, Consulting Engineers; F. J. Sarknas, Westinghouse Construction Sales Engineer; R. F. Kirkpatrick, Sales Engineer, Moore-Handley Hardware Co.; and C. H. McCauley, Architect.

J-94141-2

Planning, coordination and Westinghouse on-time delivery mean installation efficiency for electrical contractor

On the campus-like grounds around its gracious Capitol, the State of Alabama has erected a modern State Administration Building, reflecting Alabama's progressive outlook. In this newest addition to the Capitol buildings, data processing machines handle quarterly income tax notices, automobile registrations, numerous statistical reports, sales tax, etc. As many as 38 machines and other electrical equipment operate during one shift in one department alone . . . office automation that requires reliable power in large demands.

The electrical contractor, T. D. Little Electric Co., teamed up with consulting engineers, experienced Westinghouse engineers and the Westinghouse distributor to work closely with state officials, the architect and general contractor on system installation. Result: an electrical system carefully planned and executed to distribute efficiently the big power load . . . a system with expansion capability to keep the building modern for years to come . . . a system installed at a "saving" in direct comparison to other buildings on the "campus."

The electrical installation went off on schedule with building construction because of contractor-Westinghouse coordination and on-time deliveries by the Westinghouse distributor, Moore-Handley Hardware Co.

Westinghouse electrical equipment — reliable, adaptable and easy to install—was used throughout the building.

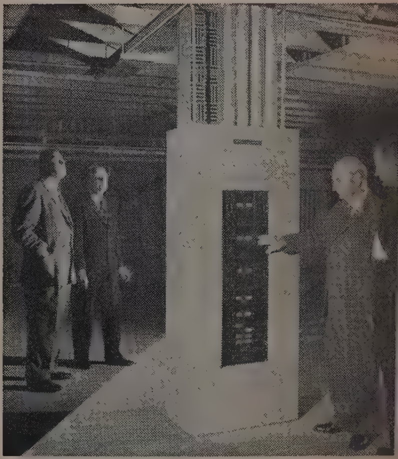
Included are a building-type switchboard, motor control center, distribution and lighting panelboards, low-impedance bus duct, circuit breakers, safety switches and fluorescent lighting. *(cont.)*

YOU CAN BE SURE...IF IT'S Westinghouse

J-94141-3

A 120/208-volt Westinghouse building-type switchboard protects and distributes power to all floors. Note blank sections for future system growth. Ventilated low-impedance bus duct, rated 3000 amps, conducts incoming power to switchboard from a bank of three 250-kva, Type SL, oil-insulated transformers. Mills Cowling, Chief of Service Division, State of Alabama; W. C. Sparks, Vice President, Moore-Handley Hardware Co., Westinghouse Distributor; T. D. Little, Sr., T. D. Little Electric Co., Electrical Contractors; and F. J. Sarknas examine future expansion features designed into switchboard.

Exhaust fan, elevator, air conditioning compressor, water pump and air handling equipment motors are served by a 480-volt Westinghouse motor control center which consists of Class 11-206 motor starters. Motor control center receives power supply from transformer vault by 1350-amp, low-impedance bus duct with many time-saving installation features. H. D. Mosley; O. E. Hatcher; William Lawrence, Jr., Deputy Director of Technical Staff, Alabama Building Commission; and C. H. McCauley inspect compact, efficient installation.



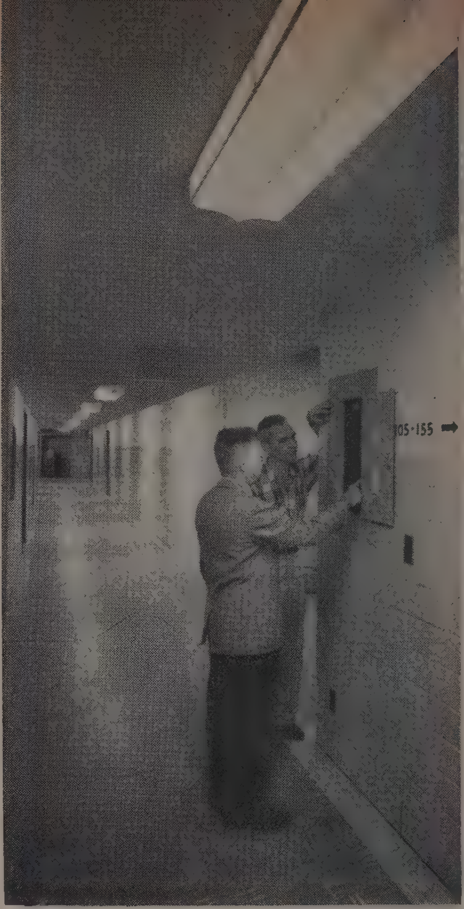
Westinghouse 1000-amp low-impedance ventilated bus duct efficiently distributes power to Westinghouse Type CDP distribution panelboard from distant switchboard with minimum voltage drop. H. D. Mosley and H. H. Houk, Director of Technical Staff, Alabama Building Commission, check neat bus duct installation as C. H. McCauley and O. E. Hatcher review circuit breaker arrangements in panelboard.

Planning, coordination and Westinghouse on-time delivery mean installation efficiency for electrical contractor *(cont.)*

Many outstanding electrical contractors have found Westinghouse equipment, coupled with localized Westinghouse service, the solution to power distribution system problems and a key way to increase installation efficiencies. Westinghouse can aid you in any phase of your electrical planning and construction. Call your Westinghouse distribution outlet or write Westinghouse Electric Corporation, Box 868, Pittsburgh 30, Pennsylvania. J-94141-4

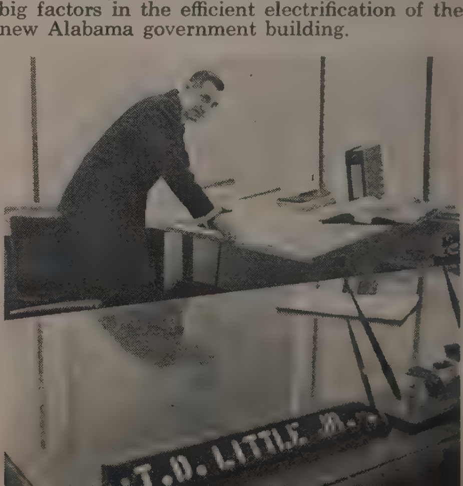
OWNER: State of Alabama
ARCHITECT: Charles H. McCauley, Birmingham, Ala.
CONSULTING ENGINEER: Mosley and Yarbrough, Montgomery, Ala.
GENERAL CONTRACTOR: A. C. Sanford, Albany, Ga.
ELECTRICAL CONTRACTOR: T. D. Little Electric Co., Montgomery, Ala.
WESTINGHOUSE DISTRIBUTOR: Moore-Handley Hardware Co., Birmingham, Ala.

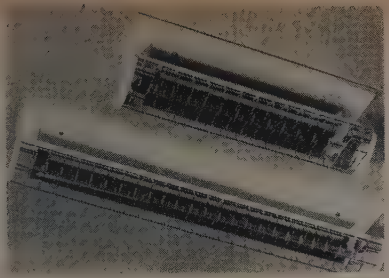
YOU CAN BE SURE...IF IT'S Westinghouse



Alabama marble and Westinghouse Mainliner fluorescent fixtures combine to form an attractive welcome for employes and visitors in new Alabama State Administration Building. Westinghouse Mainliner large area luminaires have universal ease of application with installation flexibility. *Above,* R. F. Kirkpatrick points out details of Westinghouse lighting panelboard, Type NLAB, 120/208 v, to G. D. Schnell, member of the maintenance staff. Circuit breaker panelboards provide maximum circuit protection for Westinghouse Type SC fluorescent lighting luminaires used in corridors.

Tandy Little, Jr., typifies progressive qualified electrical contractors who are helping America to Power-Up. He holds an electrical engineering degree and is president of Central Alabama Chapter of the National Electrical Contractors Association. A partner in T. D. Little Electric Co., he has responsibility for job management, contract negotiation, estimating and buying. His preplanning, business judgment and knowledge of currently available electrical products were big factors in the efficient electrification of the new Alabama government building.


T. D. LITTLE, JR.



Heater (14)

A unit heater for zone-controlled spot heating is called "Infra-Mite." Available initially in ten models, three sizes, 19½-in., 33-in. and 39-in. fixtures, there are semi-parabolic shaped reflectors and special end reflectors. Home owners and commercial users are offered a small-dimensioned heating fixture with an adaptability that allows it to attach to conduit box in an existing electrical system. Ceiling and wall mounted units are available, and a portable wall-hanging type, with cord. The 19½-in. fixture is available, 500- or 750-watt; the 33-in. model, 1000-, 1200- and 1450-watt; and the 39-in. unit, 2000-watt. Models are UL approved.

Apextro Products Co., Div. Apex Sheet Metal Works, Inc., 1821 *N. Eastlake Ave., Los Angeles* 31, *Calif.*

Truck Body (15)

New 1960 model Service-Master Body has been announced. Body is available in sizes for old or new ½, ¾, 1 and 1½-ton chassis, regardless of make. Model SM-10, 77 in. long at floor line, fits chassis having 40-in. to 42-in. cab-to-axle dimension; Model SM-15, 90 in. long, fits 48-in. to 54-in. CA chassis. Model SM-20, single rear wheels, and Model SM-30, dual rear wheels, are 102 in. long and fit chassis having 57 in. to 60 in. CA. An aerial ladder, available in two models and in 26- and 30-ft lengths, can be furnished with body. Model ML ladder is elevated by a manual hydraulic pump and Model LH ladder by a motor-driven pump powered by truck battery. Literature is available.

McCabe-Powers Body Co., 5900 *North Broadway, St. Louis* 15, *Mo.*

Voltage Regulator (16)

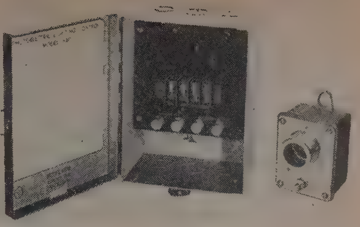
A new self-contained automatic voltage regulator called Unoreg, is for use on the low-voltage side of over 400 standard distribution transformers. Rated at 1¼ kva, the device will handle distribution transformer sizes up to and including 25 kva. A lightweight design for convenient pole mounting, Unoreg provides plus and minus 5% regulation of 120/240-volt secondary lines. Unoreg consists of an induction regulator controlled by a solid-state voltage-regulating control. Induction regulator has a new stator design which eliminates the need for a tertiary winding. Midpoint voltage setting of regulator control is 122 volts, allowing for an average secondary drop of two volts. Control is designed so that voltage is always corrected back to center of bandwidth. Device is 21½ in. high and 12¼ in. in diameter.

Westinghouse Electric Corp., Pittsburgh 30, *Pa.*

Ground Detectors (17)

A complete line of ground detectors has been developed for positive detecting of ground fault to prevent unscheduled shut-down and possible hazard, damage and expense. Model "VAP," 480 volts, is provided with an audible signal—an alarm bell that sounds when fault occurs. Signal may be silenced by acknowledge button. Acknowledge circuit is automatically reset when fault is corrected. A visual signal is also provided—a red fault light glows when fault occurs and remains lit until fault is corrected. A fault phase indication is also provided—white lights indicate which phase has gone to ground. A terminal block is provided for a remote alarm station with acknowledge button and/or indicating light.

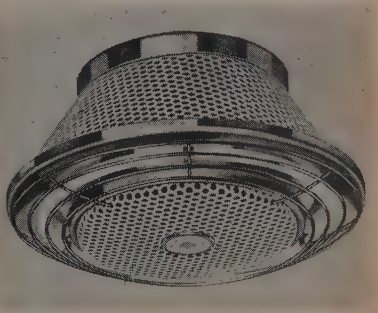
Erickson Electrical Equipment Co., 4460 *N. Elston Ave., Chicago* 30, *Ill.*



Control (18)

The new Model 6801 photoelectric control adds flexibility to a time-switch lighting control system. Unit turns lights on during any period when natural light intensity falls below a set level and time switch continues to provide preset on and off periods regardless of natural light conditions. Any combination of turn-on and turn-off by time clock or photoelectric control is possible. The photocell unit, weather-sealed in an aluminum case for indoor or outdoor mounting, contains a broad area cadmium sulfide light-sensitive cell that is hermetically sealed. Unit is connected to indoor-mounted Model 6801 control box, containing a tubeless electronic circuit with a double-pole, single-throw load contactor capable of switching up to 6000 watts.

Fisher-Pierce Co., 51 *Pearl St., So. Braintree* 85, *Mass.*

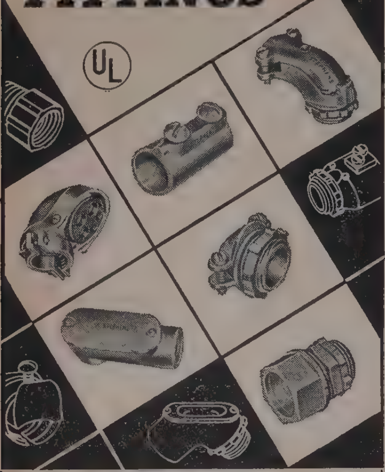


Heaters (19)

Two new bathroom ceiling radiant Halo Heetaires install like fixtures—flush mounted to ceiling—to 3- or 4-in. junction boxes. Ready to attach to standard 60° house wire, the installer runs R, T, or TW wire directly into any 3 or 4-in. junction box. They are available in two models—The Fan-Glo Halo, models 294 and 295, in 1000 and 1250 watts, 120 volts; and Radiant Halo, model 298, in 660 watts, 120 volts. Both units may be used with a 60-minute wall timer. Literature is available.

Markel Electric Products, Inc. and La Salle Products, Inc., Buffalo, N. Y.

PRECISION ENGINEERED FITTINGS



M. STEPHENS MFG., INC.

814 EAST 29TH STREET
LOS ANGELES 11, CALIF.
ADams 1-9147

THE FOLLOWING IS A LIST OF SALESMEN REPRESENTING M. STEPHENS MFG., INC.:
(* Means rep. carrying stock)

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Houston, Texas

Mr. W. A. Smith
Brenner Electrical Sales
P. O. Box 13001
Dallas 20, Texas

Mr. W. D. Reese
Brenner Electrical Sales
2608 Parkview Drive
Austin 5, Texas

***A. Lee Clifford & Co.**
1801 W. 18th St.
Indianapolis 7, Ind.

Forrest E. Durnal
1121 Edgewater Ave.
Ft. Wayne, Ind.

Charles W. Pfeiffer
c/o A. Lee Clifford & Co.
1905 Bardstown Rd.
Louisville 5, Ky.

Bill Crichton & Associates
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Mr. C. R. Maddox
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Mr. C. R. Stegin
2321 Riverside Ave.
Jacksonville, Fla.

Mr. J. R. Heidenreich
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R. H. Dirkes Co.
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Chicago 22, Ill

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11201 Frankstown
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***Keeler, White, Inc.**
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M. Morin Rivera
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***Rouzer Sales Co.**
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Minneapolis, Minn.

Leonard M. Slusser
318 Dooley Block
Salt Lake City, Utah

***Stanley Sales Corp.**
1122 Folsom St.
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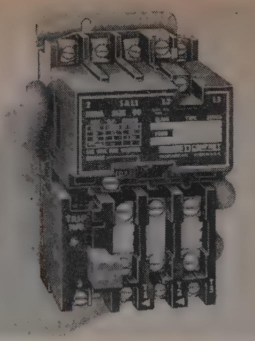
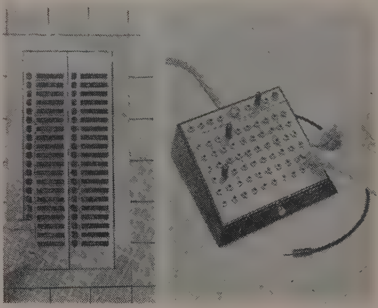


Starter (20)

New NEMA Size 00 starter has been developed for low-hp jobs. It is rated from $\frac{3}{4}$ hp 110 volts to 2 hp 440/550 volts for 3-phase service. Dimensions are $3\frac{13}{16}$ by $5\frac{3}{16}$ by $3\frac{45}{64}$ in. Starter has straight-through wiring, pressure wire terminals, molded coil and one-piece melting alloy overload relays for complete motor protection. It is available either open or in a NEMA Type 1 enclosure with optional pushbutton or selector switch in cover. It also is available without overload relays. Bulletin SM-297 is available.

Square D Company, 4041 *North Richards St., Milwaukee* 12, *Wis.*



Paging System (21)

The Pagesaver system combines a control board with miniaturized in-and-out doctors' entrance registers. Operators, before paging, can interrogate their Pagesaver control board to determine whether or not a specific staff member has registered in. If a doctor has not come in, she can leave a message alert for both herself and the doctor by inserting a cordless alert plug into the control board. Entrance registers are of a new compact design which requires a minimum of wall space. Forty names require $9\frac{1}{8}$ in. by 18 in. of wall space. Pagesaver systems can incorporate a number of entrance registers to provide access at secondary or remote hospital entrances.

Auth Electric Company, Inc., Long Island City, N. Y.

Switch (22)

The new "Two-Circuit Touchette" switch provides dim, medium and bright illumination at the touch of a button. Switch will carry 1800 watts at 120 volts, 4100 watts at 277 volts, thereby enabling single switch control of large banks of lights. At the first touch of switch button the first circuit makes contact providing dim light. At second touch the second circuit is activated providing brighter light. At third touch both circuits come into play providing full brightness. A fourth touch breaks contact completely on both circuits. Fluorescent fixture installations, cove and valance lighting for entire rooms may be controlled from one switch location.

Rodale Mfg. Co., Inc., 6th and Minor Sts., Emmaus, Pa.

Lighting Post (23)

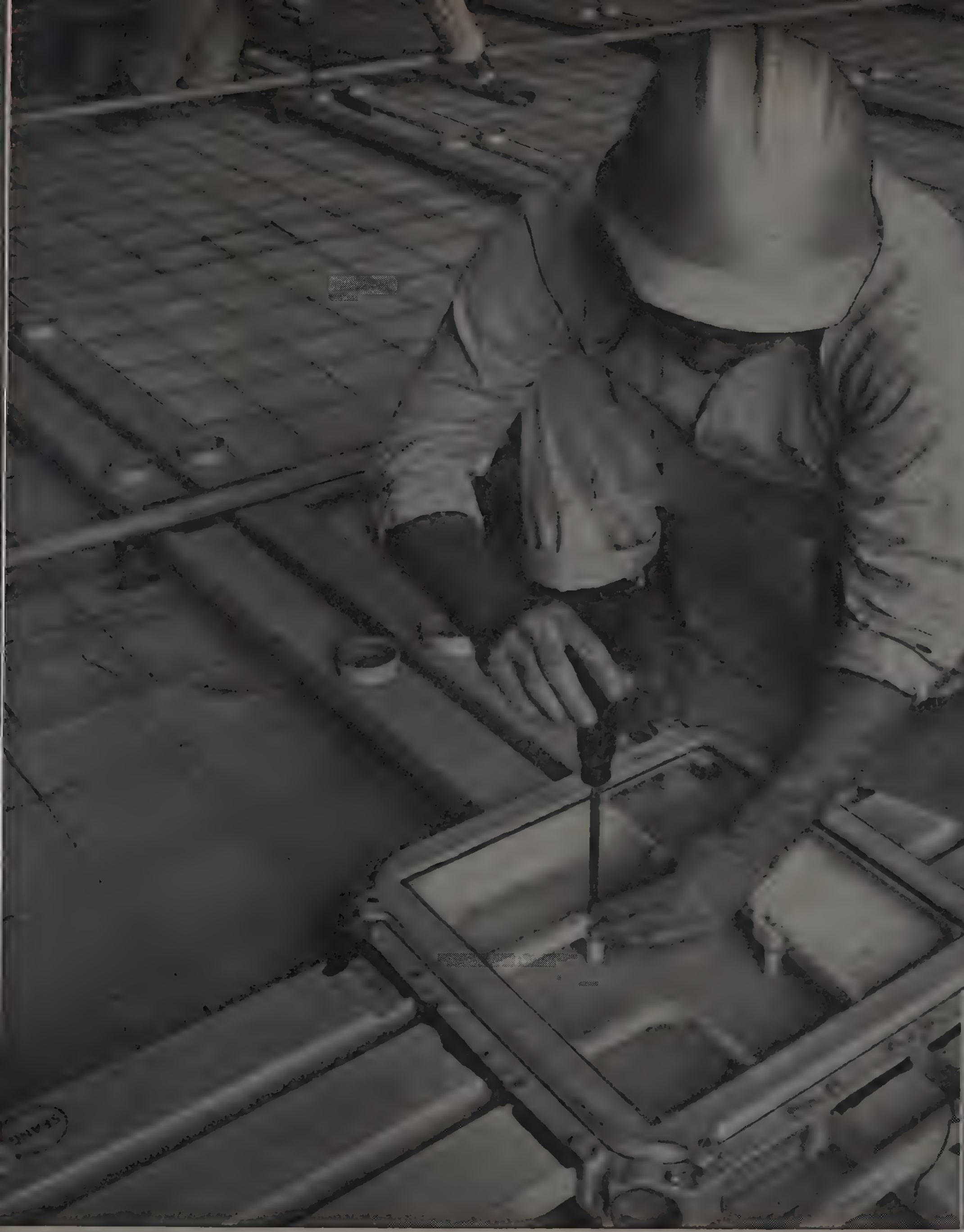
A new all-aluminum residential lighting post designed specifically for use with the Holophane 431 luminaire. Post is available in 7- and 3-ft models, the former standing approximately $5\frac{1}{2}$ ft above ground level. This model is for lighting driveways and housefronts. Smaller model standing 2 ft. above ground level is for patio and garden lighting.

Residential Lighting Div., Pfaff-Kendall, 84 Foundry St., Newark 5, N. J.

Motor (24)

New water-cooled, water-lubricated motors rated from 30 to 250 hp, 3 phase, 60 cycle, 1800 rpm, for 10-in. or larger well casings are now available. Motors are designed to be continuously submerged in water at a maximum temperature of 40°C for deep wells, booster or process applications. Motor frame is a heavy-walled, seamless-steel tubing. Epoxy coating provides protection against corrosion.

Westinghouse Electric Corp., Pittsburgh 30, Pa.



Flexible wiring system for Jacksonville City Hall with SPANG

Underfloor Duct and Headerduct. Three-duct runs of Underfloor Duct in concrete slab construction carry electrical, phone and intercom wiring on first floor. Upper 15 floors are served by Headerduct in cellular-floor construction. Simplicity of Spang Raceway Systems provided a time-saving, trouble-free installation. Future wiring changes can be made quickly, easily without costly reconstruction, making City Hall modern for years to come. For full information, write to Spang.

rchitect: Reynolds, Smith & Hills, Jacksonville
eneral Contractor: The Auchter Company, Jacksonville
echanical Contractor: Henley and Beckwith, Jacksonville
lectrical Contractor: Wesley Paxson Co., Jacksonville
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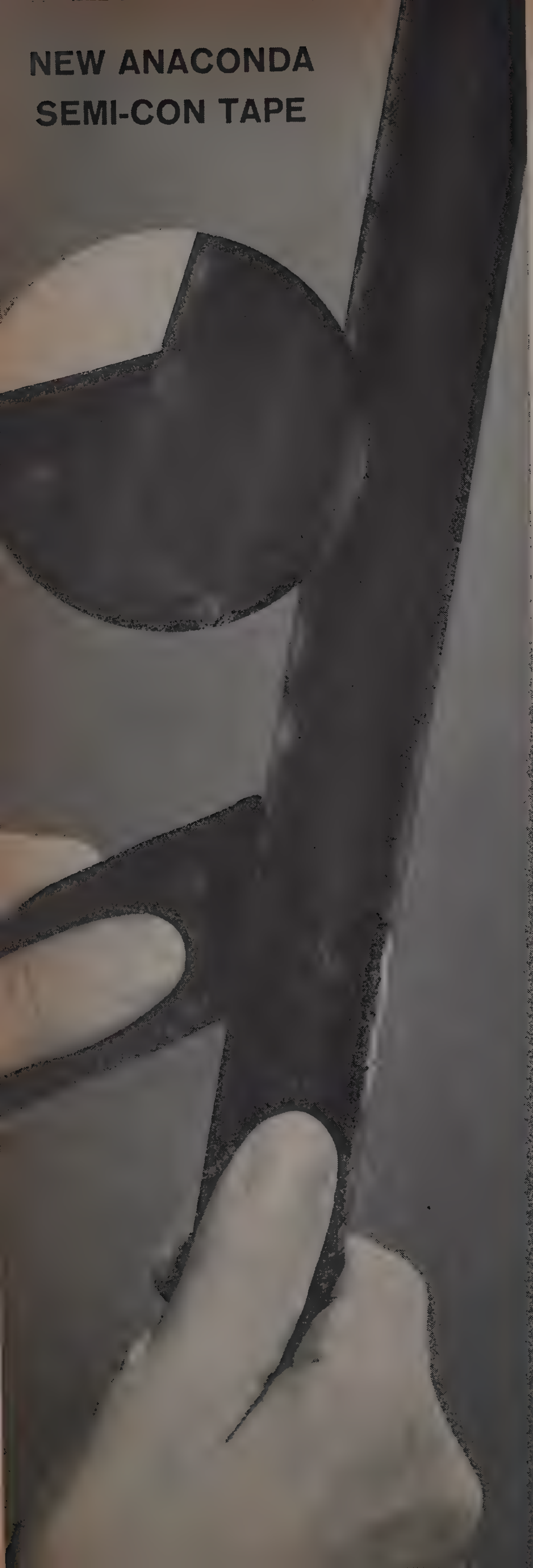
SPANG UNDERFLOOR DUCT

THE NATIONAL SUPPLY COMPANY
Two Gateway Center, Pittsburgh 22, Pennsylvania
Subsidiary of Armco Steel Corporation



NEW ANACONDA SEMI-CON TAPE

ORDINARY SEMI-CON TAPE

NOW YOU CAN GIVE YOUR CUSTOMER A BETTER SPLICE WITH HALF THE EFFORT WITH ANACONDA DURASHEATH HIGH-VOLTAGE CABLE

It has a new, clean-stripping, semi-conducting tape

PROBLEM: To make a sound, safe, high-voltage splice, every last speck of semi-conducting tape material must be removed from the insulation . . . if traces remain, chances are the joint will eventually fail. But—this important step requires tedious scraping and buffing.

SOLUTION: The new Anaconda-developed *clean*-stripping, semi-con tape*, which is an exclusive feature of Durasheath Cable. The photos (left) were taken immediately after semi-con tapes were stripped off the insulation. It takes much longer to get other cable insulation surfaces as clean. That's why this exclusive feature makes splicing a great deal easier.

The planned research and production program which brings you this outstanding cable development is also responsible for the equally important developments in Butyl rubber insulation compounding and extruding—which have produced the best possible balanced design and construction in high-voltage rubber-insulated cable obtainable today—Anaconda Durasheath.

For additional, more technical information about Anaconda Durasheath, write for Anaconda Bulletins DM-5903, covering Durasheath High-Voltage Cable, and DMS-5566, -5720 and -5735, dealing with the Splicing & Terminating of Durasheath Cable. Contact your nearest Anaconda Wire & Cable Company District Office, or write to 25 Broadway, New York 4, N. Y.

*Pat. applied for 60239C Rev.

ASK THE MAN FROM

ANACONDA®

FOR DURASHEATH® CABLE

KEEP PACE ELECTRICALLY

Arrolet CORPORATION
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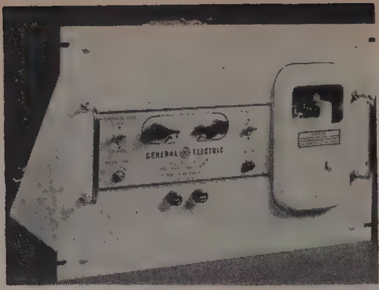
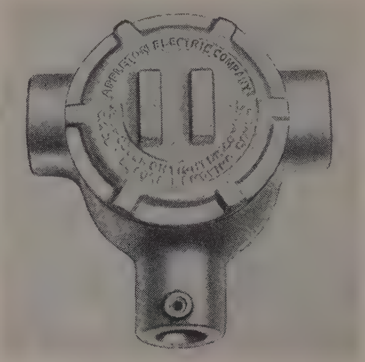
Montgomery, Penna.
Sales Representatives & •Warehouse Stocks •ATLANTA, GA. • BALTIMORE, MD. • •BIRMINGHAM, ALA. • •CHICAGO, ILL. • •CINCINNATI 37, OHIO • DALLAS, TEXAS • •DETROIT 2, MICH. • GREENSBORO, N.C. • •LOS ANGELES, CALIF. • •MIAMI, FLORIDA • •NEW ORLEANS, LA. • NEW YORK CITY, N.Y. • NEWTON CENTRE, MASS. • •PHILA., PA. • RICHMOND, VA. • ROCHESTER, N.Y. • •SEATTLE, WASH.
ARROLET ... another name for Quality!
SWITCH BOXES • OUTLET BOXES • BOX COVERS • FITTINGS



Voltage Regulators **(25)**

A new 3-phase rack-mounted Inductrol voltage regulator for use by switchboard and panelboard manufacturers. Three-phase loads up to 15 kva can be handled by this 19-in. rack design. Available either automatic or motor-driven, this regulator features no brushes, introduces no waveform distortion, and is unaffected by power factor, frequency or load. Controls are drift-free and maintain plus or minus 1% bandwidth accuracy over a temperature range of −60 C to +60 C.

General Electric Co., Pittsfield, Mass.



Fixture Hanger **(26)**

New "EFHC" explosion-proof fixture hanger is for use when suspending fluorescent or incandescent explosion-proof or dust-tight pendant lighting fixtures. Threaded hub leading from bottom of fixture stem is tapped and has a set screw to insure against conduit loosening. Series is available with ¾-in. and 1-in. feed-thru hubs in combination with ½-in., ¾-in. and 1-in. fixture stem hubs. A connection block, Catalog No. 11385, is available and fits all "EFHC" series hangers. A mounting strap can be furnished to fasten hangers directly upon a flat mounting surface. Fixture hanger Unilet has been approved by UL for Class I, Groups C and D, and Class II, Groups E, F, and G. Bulletin No. 759 is available.

Appleton Electric Co., 1701 *West Wellington Ave., Chicago* 13, *Ill.*

Disconnect Switch **(27)**

Type PEB hook stick switches are available for outdoor substation applications in the horizontal mounting position between station bus support and breaker bushing. With a momentary rating of 20000 and 40000 amps, switches have a continuous current rating of 600 and 1200 amps at voltages of 115, 138 and 161 kv. Features of switch line are adjustable front-contact mounting allowing for variations in structure elevations; positive-latch and pry-out assembly; counterbalance pring; and permanent lubrication.

Line Material Industries, McGraw-Edison Co., Milwaukee 1, *Wis.*

Motors **(28)**

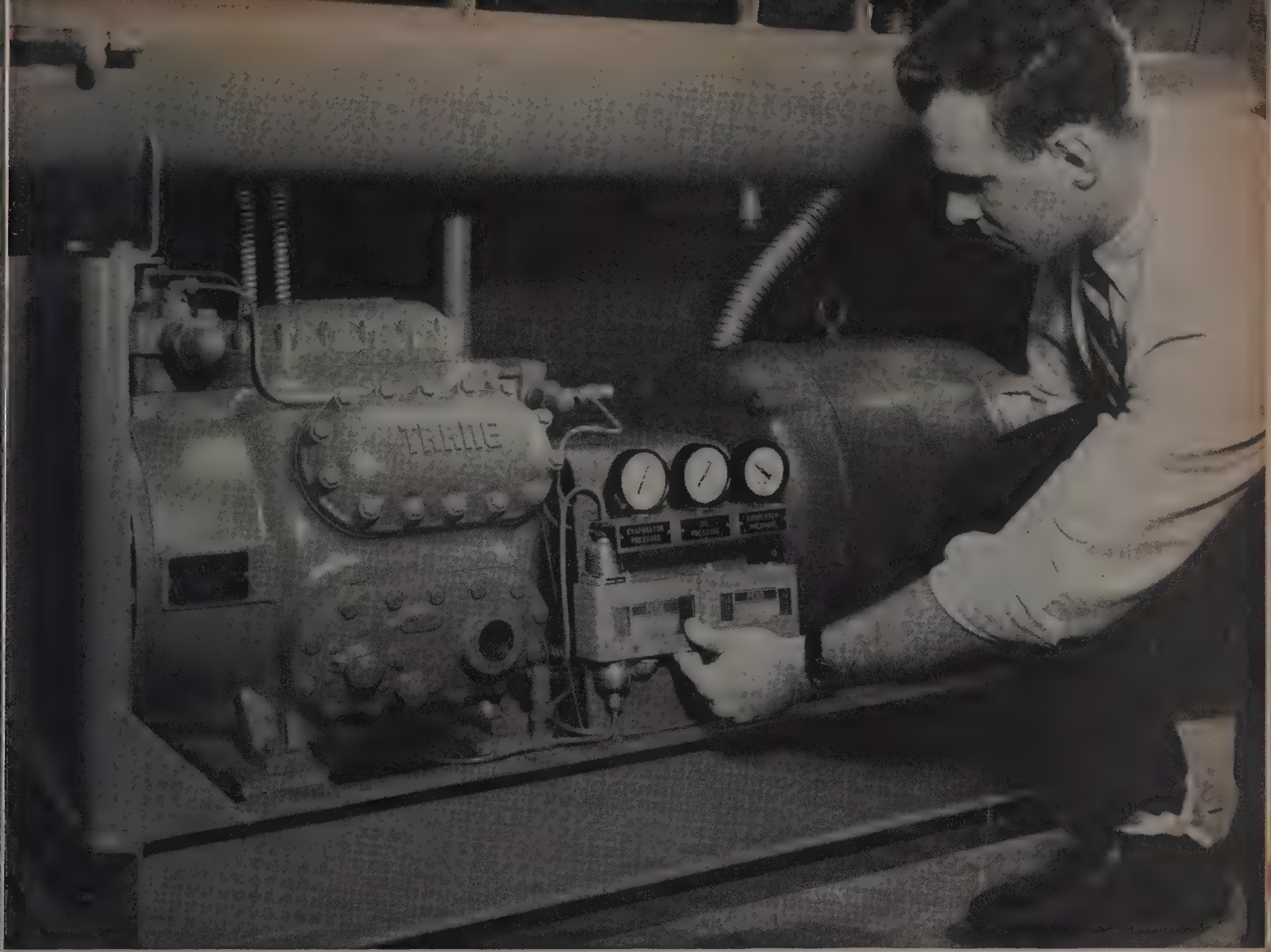
A new line of large squirrel-cage motors, 250 through 1000 hp, built for heavy-duty industrial applications. Flat steel endplates are built in two sections. Enclosure is completely drip-proof with ventilating openings so located and shielded as to provide splash-proof protection. Both stator and rotor core are constructed to permit radial as well as transverse circulation of air dissipation of heat. Available voltages are 440, 550, 2300 and 4160, 60 cycles. Entire range of ratings, 250 through 1000 hp can be supplied with full load speed of 3500, 1750 or 1160 rpm; 870 and 690 rpm motors are available through 700 hp and 575 rpm motors through 500 hp.

Wagner Electric Corp., 6400 *Plymouth Ave., St. Louis* 14, *Mo.*

Lighting Fixtures **(29)**

Three new fluorescent lighting fixtures, known as Bristol, Northwood and Colony. Shieldings offered include "Poly-Blok" louvers and color-stable polystyrene in smooth opal or clear prismatic wraparound. The new series will be supplied in 2-lamp, 40-watt, rapid start; 4-lamp, 8-ft tandem RS or 2-lamp, 8-ft slimline models and are available with or without top plates.

Keystone Electric Manufacturing Co., 2228 *East Tioga St., Philadelphia, Pa.*



New Century 30 hp part-winding start motor driving reciprocating compressor. Compressor is part of an air conditioning system in an industrial test and research laboratory.

New Century Electric motor for part-winding start

Problem: power company restrictions limit inrush current . . . a part-winding start motor is called for, but . . . acceleration must be smooth and quiet with no risk of stalling at two-thirds of full speed.

Answer: the new Century part-winding start motor.

A special winding scheme makes this performance possible. So now you can have part-winding start, dependable power and smooth acceleration all in the same motor. Century part-winding motors provide the most economical and dependable way of starting equipment such as fans, blowers, centrifugal pumps and compressors, as well as reciprocating compressors with unloading valves (like the one shown here). They are available in 20 to 150 hp sizes and in speeds of 1200 and 1800 rpm.

Why do Century Electric part-winding motors provide reliable power? Here are a few of the reasons: windings are dipped and baked with several coats of a high temperature synthetic varnish which protect against oil fumes, mild acids, dust and grit . . . rotors are dynamically balanced so motors run smoothly and quietly . . . rugged cast iron frame gives long life and reduces noise level . . . coils are insulated with a tough polyvinyl resin.

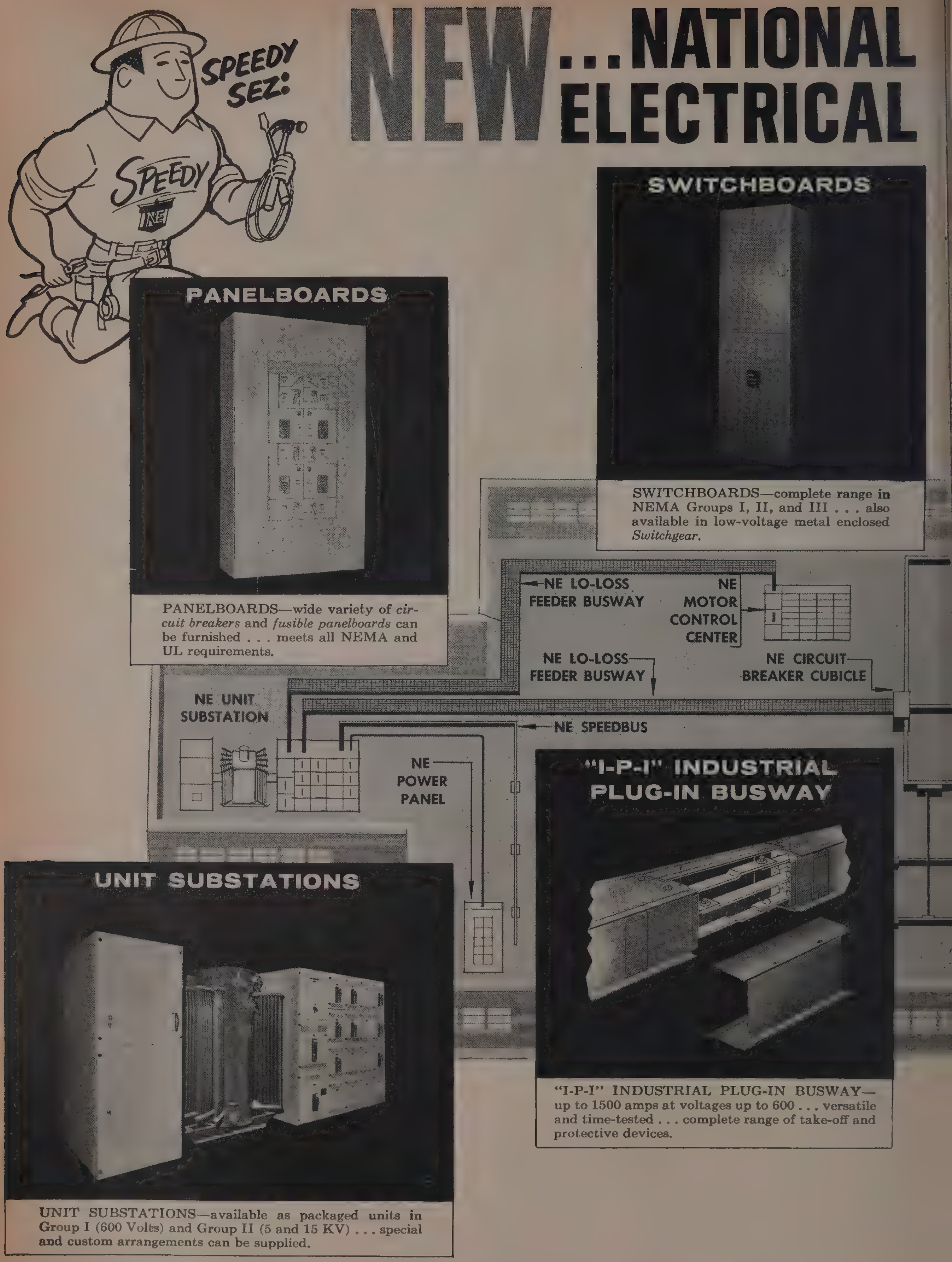
For more information on Century's complete line of motors (1/20 to 400 hp) please contact your local Century Electric Sales Office or Authorized Distributor.

CENTURY ELECTRIC COMPANY

St. Louis 3, Missouri *Offices and Stock Points in Principal Cities*

Century

60-6



NEW...NATIONAL ELECTRICAL

SWITCHBOARDS

SWITCHBOARDS—complete range in NEMA Groups I, II, and III . . . also available in low-voltage metal enclosed *Switchgear*.

PANELBOARDS

PANELBOARDS—wide variety of *circuit breakers* and *fusible panelboards* can be furnished . . . meets all NEMA and UL requirements.

"I-P-I" INDUSTRIAL PLUG-IN BUSWAY

"I-P-I" INDUSTRIAL PLUG-IN BUSWAY—up to 1500 amps at voltages up to 600 . . . versatile and time-tested . . . complete range of take-off and protective devices.

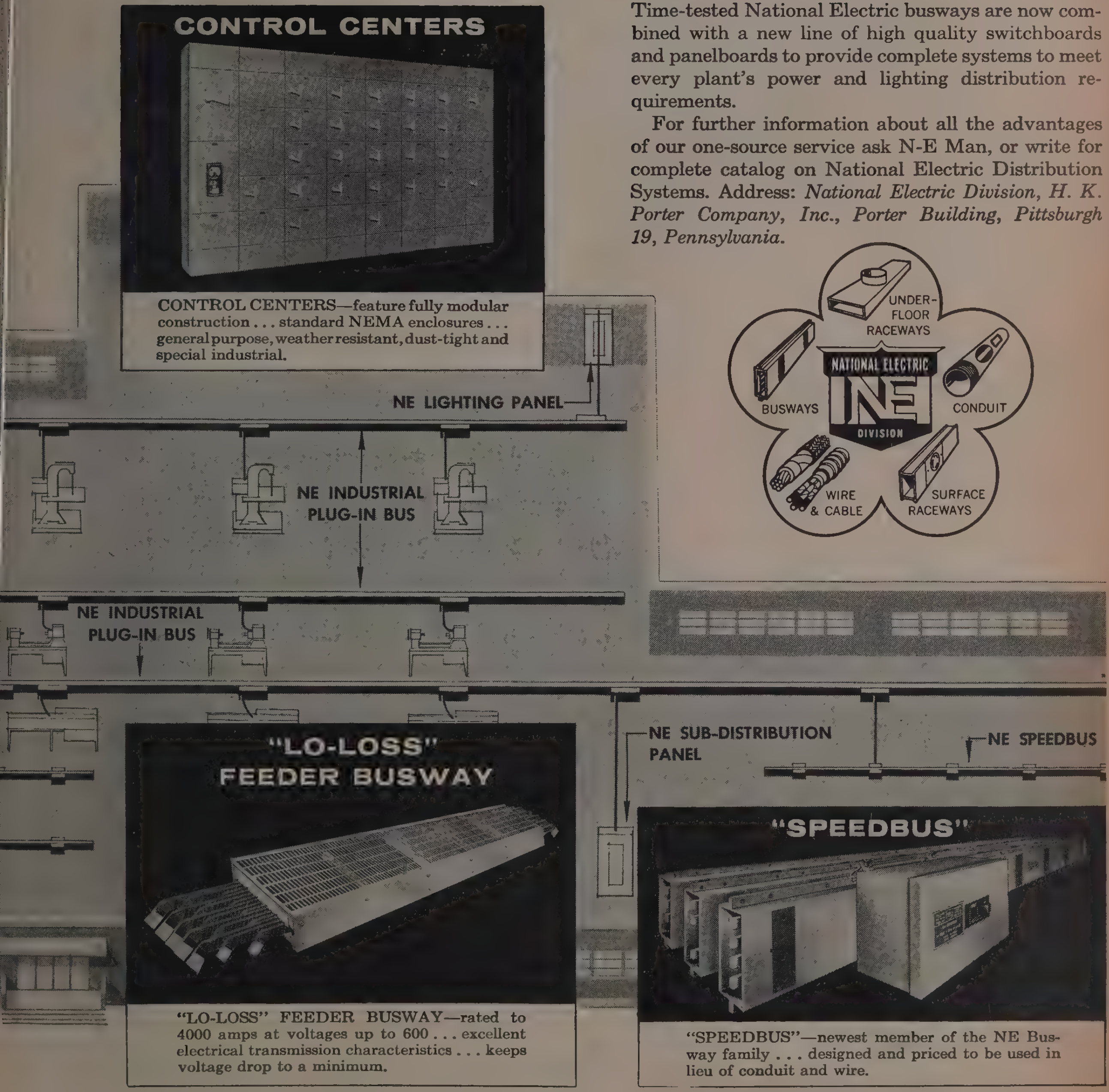
UNIT SUBSTATIONS

UNIT SUBSTATIONS—available as packaged units in Group I (600 Volts) and Group II (5 and 15 KV) . . . special and custom arrangements can be supplied.

ELECTRIC OFFERS COMPLETE DISTRIBUTION SYSTEMS

Time-tested National Electric busways are now combined with a new line of high quality switchboards and panelboards to provide complete systems to meet every plant's power and lighting distribution requirements.

For further information about all the advantages of our one-source service ask N-E Man, or write for complete catalog on National Electric Distribution Systems. Address: *National Electric Division, H. K. Porter Company, Inc., Porter Building, Pittsburgh 19, Pennsylvania.*



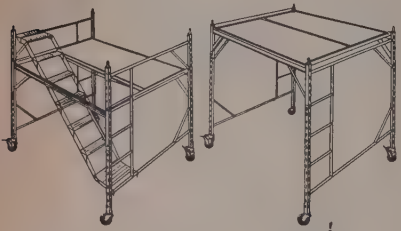
CONTROL CENTERS—feature fully modular construction . . . standard NEMA enclosures . . . general purpose, weather resistant, dust-tight and special industrial.

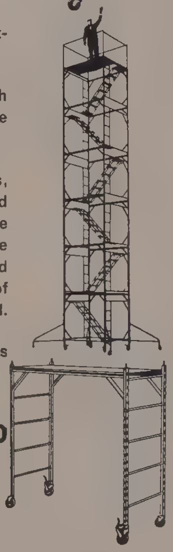
"LO-LOSS" FEEDER BUSWAY—rated to 4000 amps at voltages up to 600 . . . excellent electrical transmission characteristics . . . keeps voltage drop to a minimum.

"SPEEDBUS"—newest member of the NE Busway family . . . designed and priced to be used in lieu of conduit and wire.

NATIONAL ELECTRIC DIVISION **PORTER** ***H. K. PORTER COMPANY, INC.***

PORTER SERVES INDUSTRY with steel, rubber and friction products, asbestos textiles, high voltage electrical equipment, electrical wire and cable, wiring systems, motors, fans, blowers, specialty alloys, paints, refractories, tools, forgings and pipe fittings, roll formings and stampings, wire rope and strand.





HIGHER
and
WIDER

New BAKER
Model K Scaffold
uses standard
BAKER Scaffold components

1. Big 28 sq. ft. working platform area.

2. Platforms adjust in 3-inch increments—same as the standard Baker Scaffold.

3. Uses same side trusses, same metal-bound plywood platforms—(uses two), same casters, the same positive spring-loaded safety locks and many optional accessories of the standard Baker Scaffold.

4. Stairway, base extensions and casters optional.

THE BAKER SCAFFOLD
Standby for
maintenance and
general utility work

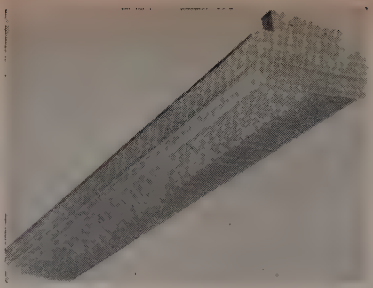
The Baker Scaffold is universally used in contracting and general maintenance work. Easy to transport, it assembles in 90 seconds; moves on large, easy-rolling casters.

The platform adjusts every three inches to any desired height and locks with positive spring-loaded safety latches. Will pass through doors, around sharp corners, over obstacles.

Write today for more complete information on these two utility scaffolds.

Listed Under Re-examination Service
Underwriters' Laboratories, Inc.

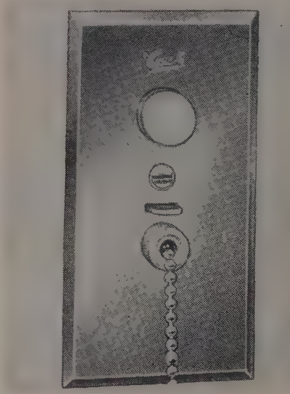
BAKER
SCAFFOLDS
DESIGNED FOR PORTABILITY • BUILT FOR DURABILITY
BAKER-ROOS, INC.
P. O. Box 892, Dept. #603, Indianapolis 6, Ind.
DISTRIBUTORS IN PRINCIPAL CITIES



Fluorescent Fixture (30)

A fluorescent fixture which features a swing-down diffuser and a hinged reflector, called PR 240-A Prisline. The prismatic plastic wrap-around diffuser unit incorporates a clear basket-design and can swing down from either side. It has longitudinal ribs on side and small pyramid design on bottom. The V-type reflector, which houses the ballast and sockets, hinges down from either side of channel. It mounts two 40-watt rapid start lamps.

Light & Power Utilities Corp., Olive Branch, Miss.



Room Station (31)

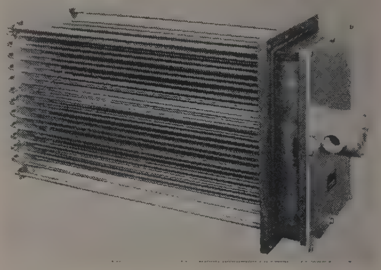
A Universal room station provides visual signal for nurse assistance. A patient calls a nurse on this room station by pulling the cord which momentarily sounds a buzzer at the supervisory annunciator and then releases the cord which lights a signal lamp at the same location. Buzzers are also sounded at duty stations, and bedside lights may also be turned on automatically when cord is released. Station is reset by pressing lever at center of plate. All Series H700 stations feature: single gang, stainless steel plate; printed circut; plastic housing; safety breakaway link; and a 6-ft nylon cord which can be sterilized.

S. H. Couch Company, Inc., 3 Arlington St., North Quincy, Mass.

Transformer (32)

A new pad-mounted transformer is designed especially for commercial suburban areas with heavy low-voltage load concentration. High-voltage and low-voltage dry-type enclosures accommodate either cable or bus work. Entire enclosure lifts away from the transformer for complete freedom in making connections. They are available in 3-phase sizes, 225 through 1500 kva with high voltages 2400 through 13,800, and with low voltages of 208Y/120 or 480Y/277.

Allis-Chalmers Manufacturing Co., Milwaukee 1, Wis.



Heaters (33)

New high-temperature duct heaters are designed for heating air or gases under conditions of high pressures, high velocities and high temperatures. They are recommended for direct heating or air process heating in large-scale drying operations encountered in nuclear power plants, wind tunnels, industrial ovens, etc., and for heat treating and annealing. Heaters are constructed of alloy sheath tubular elements mounted in a steel flange, complete with mounting holes for attaching to duct assemblies. NEMA class terminal boxes are supplied to meet specific applications.

Vulcan Electric Co., 88 *Holten St., Danvers, Mass.*

Connecting Device (34)

A new aluminum conductor connecting device, called "Jiffy Joint," is available for joining ACSR (aluminum conductor, steel reinforced) and aluminum alloy conductors. Single sleeve joint will develop the full mechanical and electrical properties of the composite joint it is designed to replace. Jiffy Joint is available in sizes to join conductors from No. 4 through 500 MCM.

Aluminum Company of America, 1501 *Alcoa Bldg., Pittsburgh* 19, *Pa.*

Some basic steps to

SILENT VENTILATION

The Most Important Step you can take when it comes to deciding *which* power roof ventilator is right for you is to look at an Ilg LSQ. If *capacity* is a prime factor, step up and see Ilg's 11 sizes: from 87 c.f.m. all the way up to 21,000.

If it's *silent operation,* then check these features: direct-connected fan and motor eliminate belts and pulleys; patented Type "Q" wheel is dynamically balanced before being connected to permanent-split capacitor 1-phase or 3-phase motors; totally enclosed constant- and 2-speed motors assure smooth power flow.

For a *first* step toward better ventilation, write for Bulletin No. 2302.

ILG ®

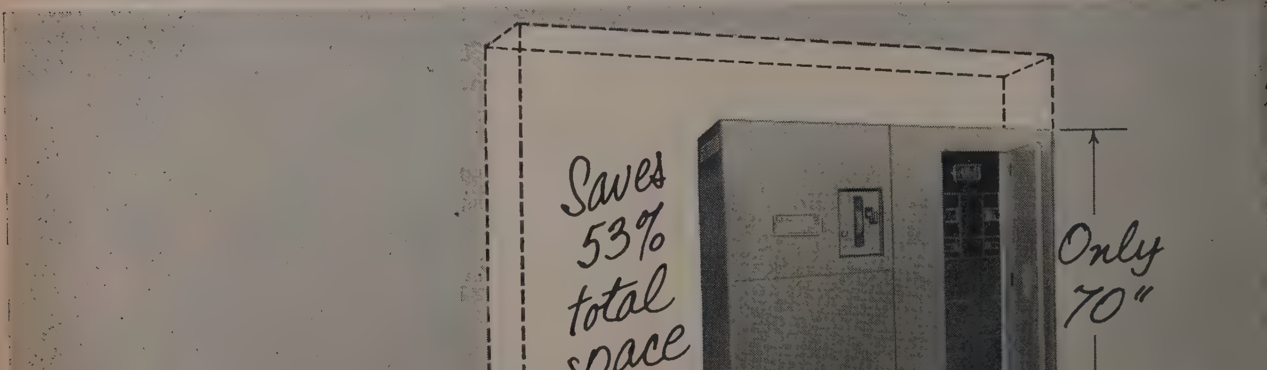
ILG ELECTRIC VENTILATING CO.

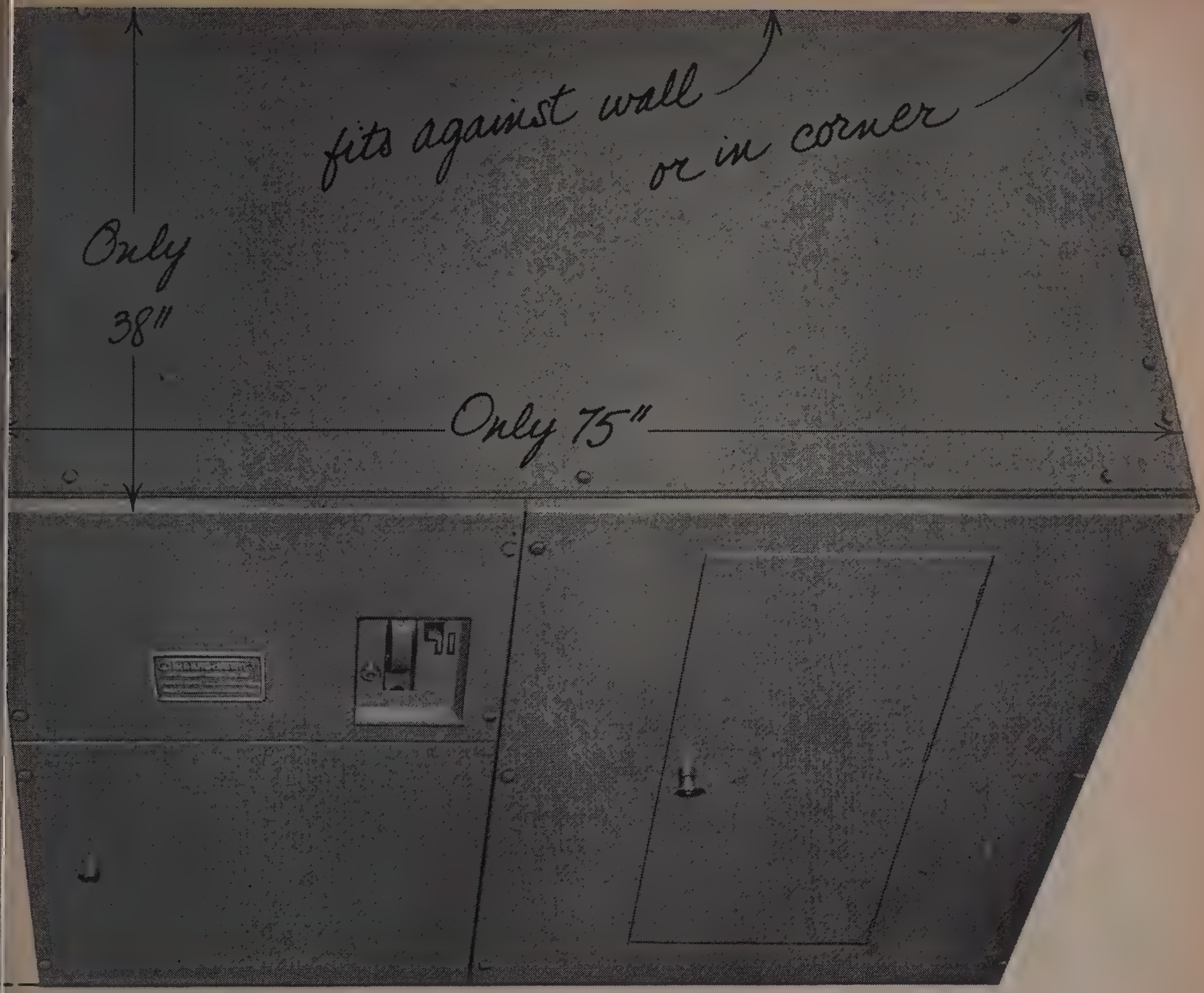
2879 N. Pulaski Road,
Chicago 41, Ill.
Offices in
60 Principal Cities

Member of Air Moving
and Conditioning
Association, Inc. (AMCA)

saves up to 13 sq. ft.

NEW SPACE-SAVINGEST





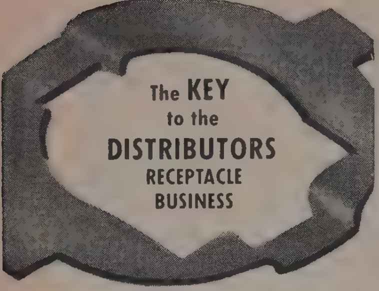
I-T-E TRANFO-UNIT®

Available in capacities up to 500 kva at 5 kv

This packaged unit substation fits in places where others cannot go. In fact, it's actually the world's most compact. 20 in. lower than the old standard, 50 in. shorter. Connects from the front. So you can put it against a wall or in a corner. Dry-type transformer and a wide choice of primary and secondary devices. Send for the complete kit of information. I-T-E Circuit Breaker Company, Dept. TR, 1900 Hamilton St., Philadelphia 30, Pa.

I-T-E CIRCUIT BREAKER COMPANY

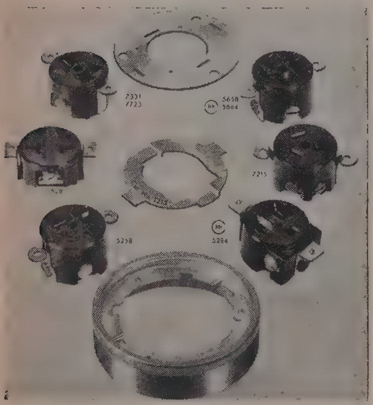
Latrobe



"UNLOCK" the source. Receptacle source now the DISTRIBUTOR'S SHELVES with these popular standards' ability to be "LAID-IN"

FULLMAN'S
Adjustable
STEEL
BOX

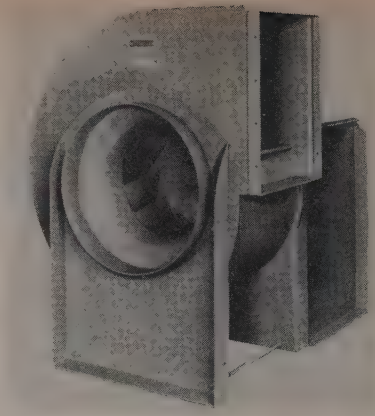
190 Series
of N R
(No Receptacle)
Boxes



TO INSTALL—You simply drop the round KEY into slots in adjusting ring—"LAY-IN" receptacle you select and "LAY-ON" receptacle ring—that's all—very simple operation

Sales Representatives
in all principal
Cities

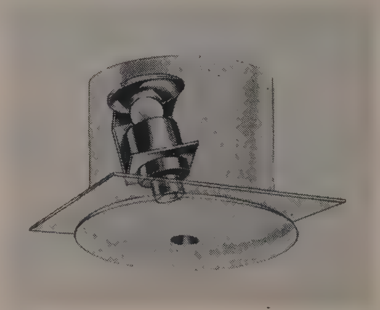
Fullman
MANUFACTURING
COMPANY
1209-1215 JEFFERSON ST.
LATROBE, PENNSYLVANIA



Ventilators (35)

New line of self-contained, belt-driven centrifugal fans featuring an entirely new principle of motor mounting. Motors and fan bearings are mounted on rubber isolation rails, providing a wide range of adjustability and allowing mounting of several different motor frames on one standard base. The Util-A-Set ventilators are designed for applications requiring low and medium ranges of volume and pressure. Backward blade or forward curve wheels are available to meet application requirements. Twelve sizes provide capacity range from 688 to 23,000 cfm. Catalog No. 3401 is available.

Ilg Electric Ventilating Co., 2850 *N. Pulaski Road, Chicago* 41, *Ill.*



Spotlight (36)

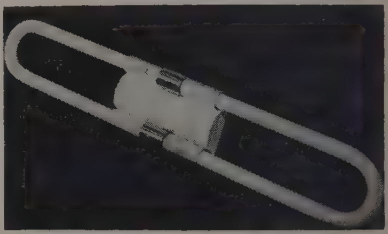
A projector spotlight which casts a beam to an exact room location has been announced. The new "Projecto-Spot" picture spotlight and adjustable downlight is capable of casting rectangles, squares and other geometric shapes to specifically illuminate pictures, corners, tables, or other desired objects or areas. Model H4170 has 4-way frame-in shutters and a projection lens system. Unit operates on one 100-watt lamp. Overall frame dimension is 11½ in. Housing dimensions are 10 in. dia and 10 in. deep.

Halo Lighting Products, Inc., 401 *W. Grand Ave., Chicago* 51, *Ill.*

Control (37)

A new controlled-speed system for centrifugal pump and fan drives, which provides variable speeds from all-electric induction motors. In most applications, the control system, designated Reactodyne, will be used where it is desirable to automatically control the pump and/or fan speeds. Control of speeds is accomplished by means of a signal from a small potentiometer which can be actuated by liquid level, temperatures, pressure, etc. Drive system is designed for use on "cubic" loads where torque requirements fall off rapidly at lower speeds. Unit is designed to operate from a standard 220/440-volt, 60-cycle ac power supply. Drive motors are available in a wide choice of horizontal or vertical types in open design. Ratings are available from 1 to 30 hp with a 2:1 speed variation.

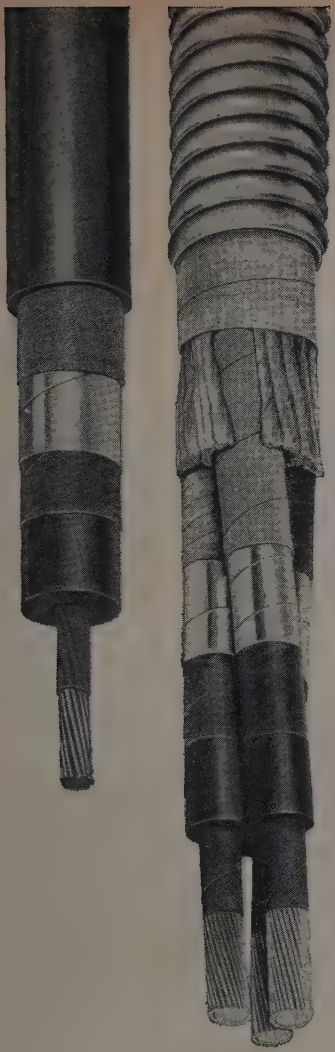
U. S. Electrical Motors Inc., Box 2058 *Terminal Annex, Los Angeles* 54, *Calif.*



Lighting Fixture (38)

A new type of lighting fixture designed to hold U-lamps. They are straight lamps which are bent by a special process into U's so that a standard 96T12 or 8-ft lamp becomes a 4-ft U-lamp giving off the same amount of light, namely 5600 lumens as a standard straight lamp while a standard 72T12 or 6-ft lamp becomes a 3-ft U-lamp giving off the same 4100 lumens as a standard straight 6-ft fluorescent lamp. By snapping two of these U-lamps into the Transolite fixture an ellipse is created either 6 ft or 8 ft in length. Fixture 8½ by 12 in. by 4½ in. can hold either two 6-ft or two 8-ft lamps. Fixtures utilize a socket with snap-in contacts on base pin. Socket floats and there is no strain on contacts. Fixture is made to cantilever tubes so lamps are suspended from fixtures without sag. Base pins are hidden by fixture. Fixture can attach to all types of raceway channels by plugging them in and locking fixture to channel.

Transolite Corp., 515 *Madison Ave., New York* 22, *N. Y.*



how good should power cable be

...for long term stability?

It isn't enough to meet or barely surpass specifications—not when it is possible to build maximum performance into power cable—as Circle does. Take, for example, the IPCEA-NEMA 60 cycle water absorption test.

Circlesheath® Type RR Power Cable Performance

In the IPCEA-NEMA "Accelerated Water Absorption Tests," Section 6.9, a sample of power cable is immersed in 50°C water for a period of 14 days during and after which time specific inductive capacity and stability factor are measured.

Not only does Circle butyl-insulated power cable far surpass all minimum specifications after 14 days immersion—*but continues to do so after one year and eight months of continuous immersion. And the test is still going on!*

Date of original immersion: September 1958 **Date of last test: April 1960**

CABLE DESCRIPTION: 15KV, UNGROUNDED, SHIELDED	CIRCLESHEATH® CHANGE SIC	PERFORMANCE STABILITY FACTOR
700,000CM	4.3%	.6%
300,000CM	3.9%	.5%
300,000CM	3.6%	.4%

IPCEA-NEMA Requirements: Change SIC 1 to 14 days: 5% max.— stability factor after 14 days: 1% max.

The manufacture of high-reliability power cable is no accident. It requires expert knowledge of compounding techniques, absolute quality control—and production men who not only care enough . . . but *know enough* to produce the very best.

Circle CIRCLOC* Interlocked Armored Cable combines flexibility with mechanical protection in one lightweight, economical construction. It trains easily over obstructions; is ideal for future plant expansion. Available in galvanized steel, bronze or aluminum armor—from 600 to 15,000 volts.

CIRCLE **WIRE & CABLE**
a subsidiary of
CERRO DE PASCO CORPORATION

RUBBER COVERED WIRE & CABLE • VARNISHED CAMBRIC CABLE •
PLASTIC INSULATED CABLE • NEOPRENE SHEATHED CABLE • CIRTUBE* EMT

New General Electric outlet protects you and your customers

See how this new GE4108 De Luxe Grounding Outlet meets today's new code requirements PLUS tomorrow's needs!

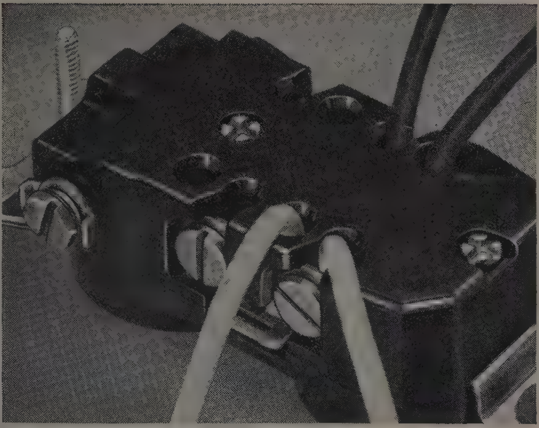
1 MEETS NEW CODES FOR KITCHENS, laundries, dining rooms, offices and other areas where high-wattage 120-volt appliances may be used. You get two 20-A branch circuits from a 3-wire, 120/240V service—or from two separate 20A, 120V circuits. Just remove one or both of the breakoff links on its sides.

2 PLUS—FULL 20A RATING in the outlet itself—not yet required by codes. General Electric provides it so full use can be made of 20A circuits.

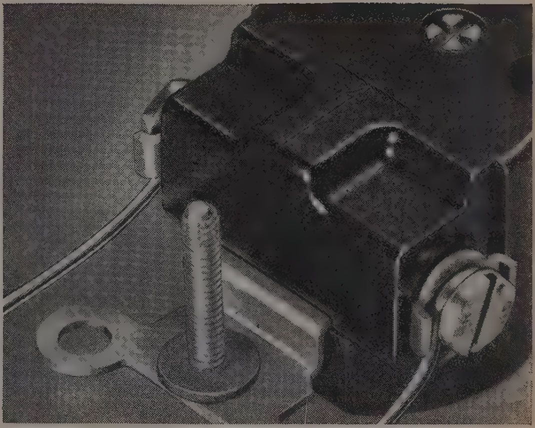
3 PLUS—GROUNDING for appliances, more and more of which will require it. Takes 20A and 15A grounding caps; polarized-parallel and parallel-pronged caps.

with "look-ahead features" from electrical obsolescence

General Electric quality features give you a topnotch installation



EIGHT HOLES FOR BACK-WIRING take all the Nos. 14, 12 or 10 Awg wires you need, "in" and "out" for through wiring—in tight, pressure-clamp connections. You can "loop" wires under screws on the sides.



TWO GREEN GROUNDING SCREWS make it more convenient for you to carry through grounding wires —take straight ends or loops. When all terminals are used, this outlet will take 10 wires!

STURDY CONSTRUCTION, with double-wipe contacts; "through" strap; captive mounting screws. No. GE4108; brown or ivory; 20A, 125V, U.L.—listed, meets Federal and REA specifications.

Plan now to use this years-ahead GE4108 Grounding Outlet wherever high-wattage outlets are indicated. It makes good sense. It gives you a wiring device you can point to with pride, to show your customers you have their best interests at heart.

Progress Is Our Most Important Product

GENERAL ELECTRIC

ONE TIME...

CLOCKS

SIGNALS

RECORDERS

... THROUGHOUT YOUR PLANT WITH A

Cincinnati

TIME SYSTEM

See the yellow pages for your local representative, or write for full information on how Cincinnati time equipment can solve your time problems.

[redacted]

SINCE 1896

IF IT'S ABOUT TIME...
CALL FOR CINCINNATI

Power Supply **(39)**

A new "RD" series of heavy-duty, regulated dc power supplies range in output from 3 to 1000 volts and from 50 to 3000 watts. They are available in six sizes for standard rack mounting. Units are completely self-protecting against damage from overload and short circuits. Good voltage regulation is obtained by use of a ferro-resonant, line-regulating transformer in conjunction with low forward-drop silicon rectifiers. A capacitance input filter reduces ripple to within plus or minus 1%.

Raytheon Company, Keeler Ave., South Norwalk, Conn.

Oil-Fuse Cutout **(40)**

Full 110 kv BIL and heavy interrupting duty are features of the new Type FC72, 15 kv oil-fuse cutout. Cutout can interrupt 7000 amps symmetrical single-phase or 100,000 kva symmetrical on 3-phase applications. Continuous load-current rating is 200 amps. Overcenter travel locks both "On" and "Off" positions. Interrupter unit with fuses and replaceable switch contacts is raised into dome above oil when cutout is switched to "Off" position. Dome cannot be opened while switch is in "On" position.

G & W Electric Specialty Co., 3500 West 127th St., Blue Island, Ill.

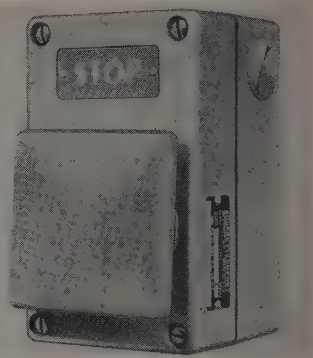
Motor **(41)**

New permanent magnet type synchronous motor called Slo-Syn, Type SS250, is designed primarily for heavy duty industrial use. It can be started, stopped or reversed instantly with a single-pole, 3-position switch. When used as an incremental positioning device, dc [redacted]
ts one revolution of
into 200 precise steps.
input 120 volts, 40/70
se, 0.6 amp maximum
cycles; 72 rpm output
ycles; 250 oz-in. torque.
Electric Co., Bristol,

Switch **(42)**

A new series of 20-amp double pole toggle switches designed in basic dimensions with standard operating characteristics. Electrical ratings are: 20-amp, 125-volt, ac, 1½ hp; 20-amp, 250-volt, ac non-inductive; 10-amp, 250-volt, ac, 2 hp. A choice of mounting arrangements, terminals, and circuitry make the switch adaptable to a variety of industrial and consumer products. Terminals come in either spade, screw, or solder type.

McGill Manufacturing Co., Inc., Valparaiso, Ind.



Press Button **(43)**

A new palm-operated press button for stamping presses is available for mounting in a machine cavity or in its own oil-tight enclosure. It has heavy-wall die-cast construction. Cover screws are self-retaining and terminals are readily accessible. Conduit openings are positioned for convenient installation. Plates are color-coded for identification. Standard button is equipped with a non-telegraphing single-pole double-throw snap switch, but is also available with two switches for double-pole double-throw action when required. Bulletin SM-294 is available.

Square D Company, 4041 North Richards St., Milwaukee 12, Wis.

Cabinet **(44)**

New Model 14 console cabinet for mounting electrical and electronic machine controls is designed for industrial use. Unit is oil- and dust-tight and is made of 14 gauge steel. Sloping top has a hinged, removable panel on which user can mount control buttons, switches and meters. Panel is at operator level, 32 in. from floor. One or two 24-in. by 18-in. sub-panels can be installed inside console body. Either stationary or swingout panels are available for this purpose. Vertical racks are also available for mounting electronic chassis inside body instead of sub-panels. Console is 50 in. high, 24 in. wide and 23 in. deep.

Hoffman Engineering Corp., Anoka, Minn.

Drill hole for anchor using Skil Roto-Hammer and new "Flat-Tip" carbide bit. Holes have virtually flat (160°) bottoms.

Clean out hole. Insert expander plug in anchor and drive home with claw hammer or mallet. Total elapsed time: 25 seconds.

New Skil method sets anchors* 400% faster at 1/3 the cost . . .

using Model 726 Roto-Hammer and new Skil "Flat-Tip" Carbide Bits

COMPARISON TEST Based on setting 1000 self-drilling anchors for ⅜" bolts in $\frac{9}{16}$" diam. holes (labor at $3.00 per hr.)	**NEW SKIL METHOD**	1 No. 23536 Flat-Tip Bit used	6.80 hours labor required	$37.40 total cost (labor and bit)	3.7¢ cost per anchor setting
	CONVENTIONAL METHOD	1 chuck wrench needed	28.33 hours of labor required	$94.52 total cost (labor and chuck wrench)	9.4¢ cost per anchor setting

NOTE: Cost of anchors (same for both tests) not included.

Automatic Power Rotation. Model 726 drills holes without tiresome hand turning of star drills. Low maintenance. No springs to break.

Ask your Skil distributor for a demonstration. Look under "Tools—Electric" in the Yellow Pages. Or write Skil Corporation, Dept. 130I, 5033 Elston Avenue, Chicago 30, Illinois. In Canada: Skiltools Limited, Trenton, Ontario.

*Self-drilling and expansion type shields, also new types about to be announced.

SKIL . . . AND SKILSAW POWER TOOLS

If you just figure the cost of lamps you only know about 1/10th of the story!

Only a **Total Cost**

# of Lighting analysis can show

• where the money really goes
• how you can really cut expenses

HOW TO FIGURE YOUR TOTAL COST OF LIGHTING (TCL)

(Calculations shown here are based on the average 7500-hour operating life of a standard Sylvania 40 CW lamp which requires 46 watts of power including ballast.)

	National average per lamp	Put your costs here
1. **Net cost per lamp** (at average discount of 35%)	$ .81	
2. **Power cost per lamp** based on average industrial rate of 1.5¢ KWH (watts × 7500 hours ÷ 1000 = KWH)	5.18	
3. **Maintenance cost per lamp** (one cleaning plus one replacement figured at average industry rate of $3.00 per hour)	2.00	
Total Cost of Lighting (TCL) per lamp	7.99	
TCL for 100-lamp installation	$799.00	
(**Note:** If you use 100 Sylvania lamps, figure the 8% extra lighting value of 8 lamps over 100 ordinary lamps.*)	× .08	
Saving through extra Sylvania lighting value*	$ 63.92	

*These are the extra dollars you would have to spend per 100 ordinary lamps to get the equal lumen hours of light you get from Sylvania.

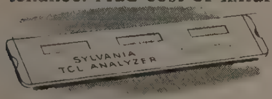
Sylvania is so sure savings will result from figuring this way, we'll even send our representative to show you how (or you can do it here — now!)

With cost of lamps amounting to only about 10% of your *T*otal *C*ost of *L*ighting (TCL), why should Sylvania be so interested in this new over-all way of figuring? Two good reasons:

First, because TCL best demonstrates the over-all superiority of Sylvania fluorescents.

Second, because we believe that just in figuring TCL you'll discover a number of new opportunities for shaving costs. And that's one of the things we like to help you do.

What *is* your TCL? Cost of lamps *plus* power *plus* maintenance. Add cost of fixtures, too, if you're remodeling.



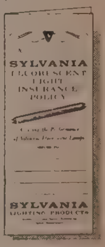
WITH TCL ANALYZER, a Sylvania representative can figure in minutes how the special conditions in your plant affect Total Cost of Lighting.

Our representative can help figure special conditions in your plant. With his Analyzer Kit, he can do it in minutes, give you a complete lighting analysis *free.*

He can also show you how and why, for every penny you spend for lamps, power and maintenance, you get more value with Sylvania.

And he'll show how Sylvania backs its claims to lowest TCL with an *exclusive* Light Insurance Policy. *Guarantees* Sylvania fluorescents will perform better *in your own opinion* than the brand you are now using—or your money back!

Call your Sylvania representative. Or write us: Sylvania Lighting Products, a Division of Sylvania Electric Products Inc., Dept. 15, 60 Boston St., Salem, Mass. In Canada: Sylvania Electric (Canada), Ltd., Box 2190, Station "O," Montreal 9.



EXCLUSIVE SYLVANIA LIGHT INSURANCE POLICY is your guarantee of lowest TCL — or your money back!

SYLVANIA

Subsidiary of **GENERAL TELEPHONE & ELECTRONICS**

From nuclear power to electric energy...

POWERIGHT PARANITE®

POWER CABLE

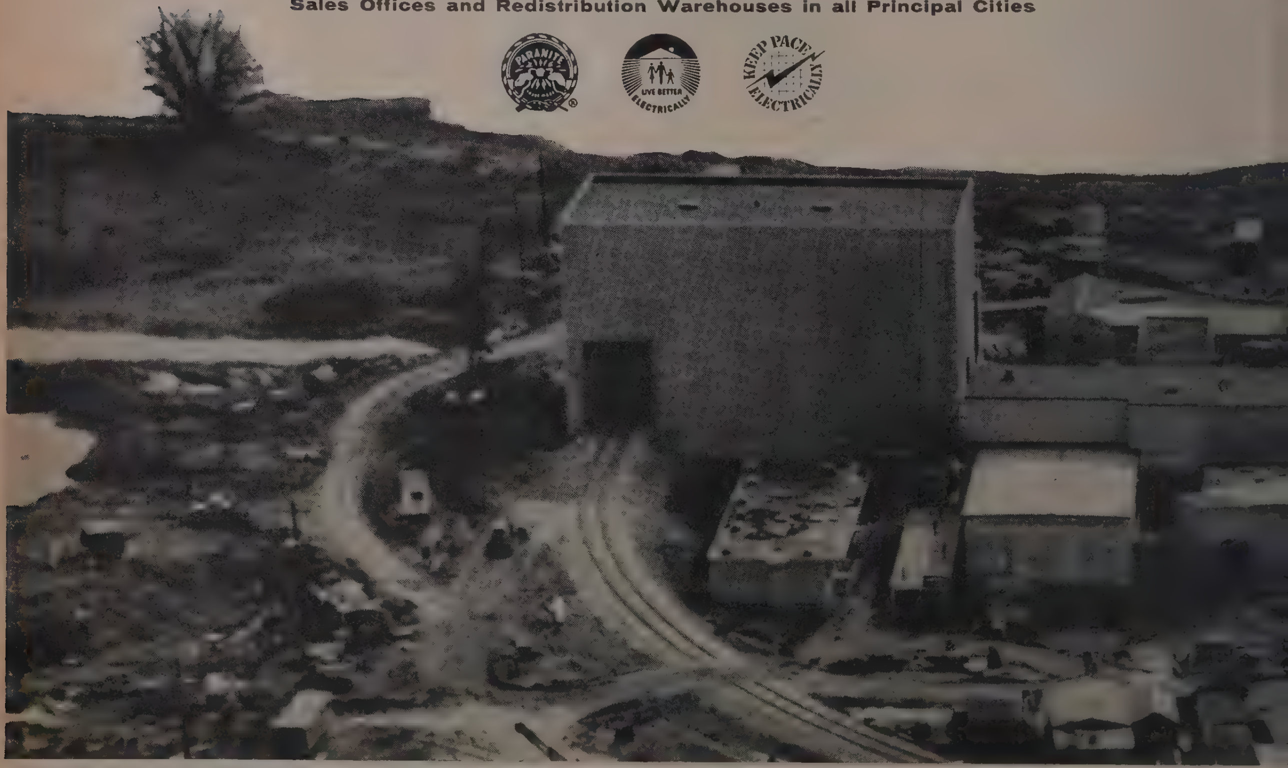
The new **Enrico Fermi Atomic Power Plant** near Monroe, Michigan, will be operated by Power Reactor Development Company and The Detroit Edison Company for the expressed purpose of demonstrating the practicability of the use of nuclear energy for the generation of electric power. Criticality is scheduled for December 1960.

Paranite Wire and Cable was selected to supply 600 Volt network and 5000 Volt shielded cables for the nuclear section of this major new development. To us it's evidence once again of the nationwide acceptance of Paranite's 70-year record of dependability.

From 600 volt network through 28,000 volt power cable, Paranite's complete line is ready to serve you. If yours is a special application problem the Paranite engineering department invites your inquiry.

Since 1890

PARANITE WIRE & CABLE DIVISION
ESSEX WIRE CORPORATION, Marion, Indiana
MANUFACTURING PLANTS: Marion, Ind.; Jonesboro, Ind.; Tiffin, Ohio; Anaheim, Calif.
Sales Offices and Redistribution Warehouses in all Principal Cities



A. Paranite HIGH VOLTAGE CABLES are manufactured in a complete range of sizes—1000 through 28,000 volt single conductor, 3000 and 5000 volt three conductor. Adaptable for aerial, direct burial or underground duct installation, wet or dry location.

B. Paranite manufactures a complete line of 600 volt NETWORK CABLES in gauge sizes through 2,000 MCM. Insulations available include 60°C, 75°C and 90°C types for use in either wet or dry locations.

Paranite also makes a complete line of quality building wires.

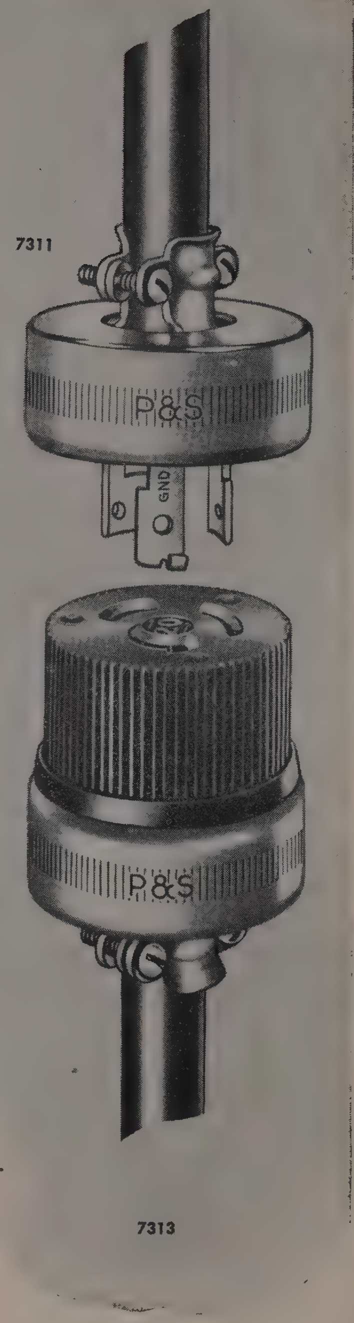
P&S TURNLOK

Built
to
Take It

P&S TURNLOK wiring devices are designed to give trouble-free service no matter how tough the going gets. TURNLOK devices are available in 10 and 20 Amperes, 2-, 3-, and 4-wire types: receptacles, connectors and caps.

All P&S TURNLOK devices have extra large head binding screws and ample wireways for quick, easy wiring. Armored sections are anchored securely. Cap blades are positioned accurately. Contacts are anchored securely. Fastening screws in connectors are secured in body . . . cannot fall out in wiring. Ratings are plainly visible.

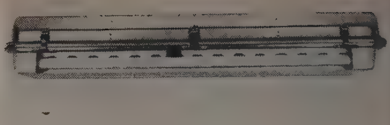
For information about P&S TURNLOK Line, write Dept. ECM-96.



PERFORMANCE
SPECIFIED

P&S®
PASS & SEYMOUR, INC.
SYRACUSE 9, NEW YORK

60 E. 42nd St., New York 17, N.Y. 1440 N. Pulaski Rd., Chicago 51, Ill. In Canada: Renfrew Electric Co., Ltd., Toronto, Ontario



Luminaires (45)

Thermoelectrically cooled fluorescent luminaires can be applied in all areas of outdoor lighting. Used with any high output lamp, the thermoelectric device inside the fixture automatically adjusts to different lamp bulb diameters. Luminaire is a 6-ft, 4-lamp, shallow unit employing four Peltier thermoelectric heat pumps for spot-cooling the fluorescent lamps. In heat pump direct current flows through junctions of dissimilar metals, absorbing heat in one junction and liberating heat in the other.

Line Material Industries, McGraw-Edison Co., Milwaukee 1, Wis.

Heater (46)

A new heavy-duty fan-forced wall Heetaire, H260 Series, is designed for permanent or occasional heat. Basic Heetaire in all wattages is available in two types; one for recessed mounting in standard 2- by 4-in. on 16-in. center frame walls, and the other for surface mounting on masonry construction. Heaters are equipped with an automatic reset safety switch which disconnects elements and motor if air flow is obstructed in any way. Built-in automatic thermostat control and separate on-off switch are included as standard equipment. Literature is available.

Markel Electric Products, Inc. and LaSalle Products, Inc., Buffalo, N. Y.

Product Briefs

(47) The series of three downflo units by Wesco central, forced fresh air electric **furnaces**, with optional air conditioning, has been approved by Underwriters Laboratories, Inc. Manufacturer is Northwest Foundry & Furnace Co., Wesco Furnace Div., Portland, Ore.

(48) Pennsylvania Transformer Div., McGraw-Edison Co., Canonsburg, Pa., has announced a new fully **insulated cover** as a standard item for their distribution transformers. . . . (49) New extra heavy NEMA Type 12 **panel enclosures,**

LOW COST LABOR-SAVER for EVERY CONTRACTOR!

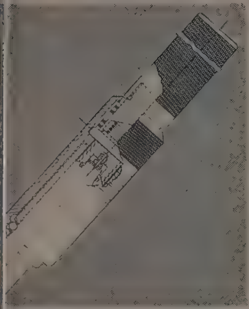
Completely NEW

JET LINE GUN!

ACTUAL SIZE

Small enough to carry in your pocket!

Cartridge in place for launching



AIL DRAWING SHOWING
ONSTRUCTION OF GUN

Fast, safe, easy to use...for all large conduit from 1¼" thru 6"

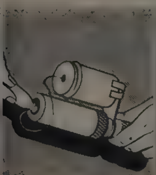
NOW ONLY

$24.50

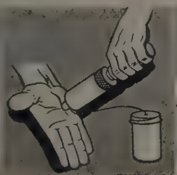
COMPLETE NO. 1110 KIT

(Jet Line Gun Only, $19.50)

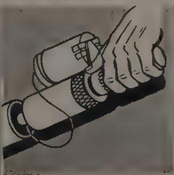
contains: **New Jet Line Gun • Line Can, Nylon Line • Jet**
ne Cartridges • Nylon Line Packages • Line Can and Package
lder • Cartridge Nose Cone Extensions • Extra Needles



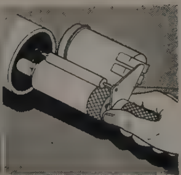
. Tie nylon line to cartridge and insert in Gun.



2. Push cartridge all the way back—hard—to puncture and lock in place.



3. Set cartridge into the conduit and release by pushing large barrel forward with thumb. One click does the trick!



4. Over 125 ft., use line package which reduces pull and lays a line as it goes.

RUGGED • POSITIVE ACTION
TROUBLE-FREE • COMPACT

This entirely *new*, improved Jet Line Gun costs only *one third as much* as the former model! No contractor can afford to be without it!

The new Jet Line Gun launches a self-propelled cartridge that lays a strong nylon line through large size pipe in *seconds*. Save *hours* on conduit wiring jobs. Distances up to 600 ft. Your Jet Line Gun pays for itself over and over again! The new Jet Line Gun . . . and the Jet Line Cylinder system for small conduit, gives you a new method that can save you up to 70% of your wire pulling costs.

**Pat. #2,930,584*

Use the Jet Line Cylinder System for small conduit—½"- ¾" - 1"

Ask your distributor or write

JET LINE PRODUCTS, INC.

615 FUGATE AVE., CHARLOTTE 5, NORTH CAROLINA

manufactured to current JIC standards, are available from Keystone Manufacturing Co., Warren, Mich.

(50) Beaver Pipe Tools, Inc., Warren, Ohio, announces a new improved Electrimatic **chuck,** which is available on either their Speed-O-Matic or Model A pipe machines. . . . (51) A new, electric **wall thermostat** that controls both oil and gas heater temperatures between 55 and 85-degrees F has been introduced by the Heating and Air Conditioning Div., Controls Co. of America, Milwaukee, Wis.

(52) Ceilheat, Inc., Knoxville, Tenn., has developed a new **thermostat,** called the "Room Mate" for use with their electric radiant cable heating systems and baseboard units. . . . (53) A new **compound,** called Alum-N-Eas, which stops binding and seizing of aluminum conduit connections, has been introduced by Electro Compound Co., Cleveland, Ohio.

(54) Sequoia Wire & Cable Co., a subsidiary of the Anaconda Wire & Cable Co., New York, N. Y., has announced the availability of new **flexible tubing**—designated as Hyshrink—which shrinks to form tight bond. . . . (55) Talk-A-Phone Chief Redi-Power, a new all-transistorized model, designed to overcome high noise levels and provides complete **intercommunication,** has been introduced by Talk-A-Phone Co., Chicago, Ill.

(56) Associated Research, Inc., Chicago, Ill., has announced their Model 293 Vibroground, a new **instrument** for measuring soil resistance. . . . (57) A new Porcelain pull **receptacle** with a 3-wire "U" ground convenience outlet has been added to the line of porcelain electrical wiring devices by Circle F Manufacturing Co., Trenton, N. J.

(58) Sylvania Electric Products Inc., New York, N. Y., has announced a new white **fluorescent lamp** known as the "Natural White" created primarily for use in stores, restaurants, and public gathering places. . . . (59) Temp-R-Tape TSP, a new pressure-sensitive Teflon **tape** for extreme high-temperature design, has been developed by the Connecticut Hard Rubber Co., New Haven, Conn.

(60) Wood Electric Corp., Lynn, Mass., announces their new miniature combination toggle **switch and circuit breaker** which weighs less than 50 grams.

Catalogs & Bulletins

(61) Circuit Breakers. Bulletin 7213, 16 pages, covers Type AF frame-mounted oil circuit breakers with ratings of 23, 34.5, 46, and 69 kv. Federal Pacific Electric Co.

(62) Bus Duct. Application Data 30-663, 12 pages, gives drawings, specifications, and engineering data of high-frequency bus duct for induction heating systems and other applications. Westinghouse Electric Corp.

(63) Ballasts for fluorescent lamps are covered in Bulletin GEC-983P, 20 pages, including tables of operating data and prices. General Electric Co.

(64) Magnetic Clutch. Low-cost Magneclutch is described in 4-page bulletin, including construction and operating features, performance curves, and cutaway drawings. Vickers Inc.

(65) AC Motors for low head submerged pumping, single phase and 3-phase, ranging from ¾ to 40 hp, are covered in Bulletin F-1976. U. S. Electrical Motors Inc.

(66) Switchgear Equipment. Bulletin GEA-6623B, 8 pages, describes redesigned switch and fuse equipment incorporating rollout feature for easy maintenance. General Electric Co.

(67) Ventilating Troffers. Bulletin B, 44 pages, describes Lumi-Flo troffers, by which cool and warm air may be provided from the same concealed ceiling fixtures for offices, schools, hospitals, hotels, and stores. Thomas Industries Inc.

(68) Diffusers for luminous ceiling lighting applications are covered in Technical Release No. 8, giving complete specifications and instructions for installation and maintenance. Union Carbide Plastics Co.

(69) Power Fastenings for electrical equipment. Application Bulletin A-27 gives complete details for fastening into concrete, masonry, brick and steel with new power-piston tool. Hilti.

(70) Motor Selection Guide, GED-3909A, is a 3- by 7-in. pocket-size card tabulating data for both dripproof and totally enclosed fan-cooled Tri-Clad squirrel cage horizontal motors. General Electric Co.

(71) Unit Heater incorporating a fused quartz element for use in such areas as swimming pools, sun porches, patios, and bowling alleys, is described in new literature. Units are rated at 500, 750, 1000, 1450 and 2000 watts. Apextro Products Co.

(72) Condulets for corrosive locations. Bulletin 2699, 20 pages, gives information on corrosive substances, with descriptions of Condulet metals and finishes. Crouse-Hinds Co.

(73) Lighting Layout for baseball field is given, with pole types, mounting heights, type and number of floodlights, and load requirements for infield and outfield, in 1-page Bulletin OLP-1014. General Electric Co.

(74) Toggle Switches. New bulletin describes new 0111 series of 20-amp toggle switches, including circuitry, ratings, and operation. McGill Mfg. Co., Inc.

(75) Motor Protection. New Everseal silicone rubber protection against adverse environments for windings of form-wound motors, 150 hp and up, is covered in Bulletin F-2022. U. S. Electrical Motors Inc.

(76) Lighting Layout for poster panels and highway guide signs is shown in 1-page Bulletin OLP-1009, including sample problem and solution, recommended illumination levels, and formula for computing number and type of units required. General Electric Co.

(77) Insulating Oils for transformers and cables are discussed in new 6-page Bulletin 58, including information on functions, characteristics, properties and uses. Sun Oil Co.

(78) Underwater Floodlights, vaportight lighting fixtures, walk and pole lights, and outdoor receptacles are described with complete specifications in 4-color Bulletin 3-A, 38 pages. Russell & Stoll Co. Inc.

(79) Stepping Motors. Data Sheet No. 1, 4 pages, explains use of Slo-Syn synchronous motors as dc stepping motors, with diagrams and characteristics charts. Superior Electric Co.

(80) Electromagnetic Controls. Catalog accessory kit 57-SAK-1 contains up-to-date catalog sheets on battery chargers, automatic transfer switch accessories, and controls. Automatic Switch Co.

compare

CLARK CONTROLS...

NEW Push
Button Line

"PM" Relay Line...

with new "Color-Selective"
Conversion Kits

Type "CY" Starters...
the standard for longer
operating life

SEE FOR YOURSELF WHY
THEY GIVE YOU MORE THAN
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The
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NEW Clark Push Buttons with exclusive wipe action contacts give you more

WIPING CONTACTS—a Clark Controller exclusive—assures minimum contact resistance at all times. As contacts close, unique Clark design creates a sliding action that wipes faces clean of dust and oil.

DUAL COLOR-CODING—buttons and ferrules—in many separate colors, makes possible advantageous color-coding of stations both by individual operating function and group function.

THREE TYPES OF UNITS offer greater flexibility for any application:

- Type HO Oiltight—Panel or Base Mounted
- Type H NEMA I—Base Mounted
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The new Clark Push Button line includes a complete range of buttons, selector switches, pilot lights and push-to-test lights or lighted push buttons—available as individual control units or mounted in enclosures or on flush plates.

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see for yourself why...

Clark Type "CY" Starters give you more than any other A-C magnetic starter

Whatever your basis for comparison let your own performance check show you how Clark Type "CY" Starters outperform all other starters—give you more.

DEPENDABILITY? Compare the Clark Type "CY" Starter in the toughest application you can find—then see for yourself how it continues to operate dependably where other starters fail.

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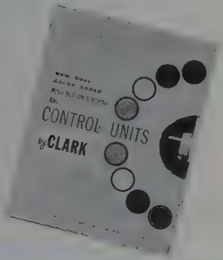
Clark Type "CY" Starters are available in many combinations, in sizes 0 thru 4, and in a variety of enclosures and forms to meet every industrial application.

More for your money with

CLARK PUSH BUTTONS

DEMONSTRATION? Ask your local Clark distributor or district sales representative for a demonstration and free literature on the new push button line. Or, write direct to The Clark Controller Company.



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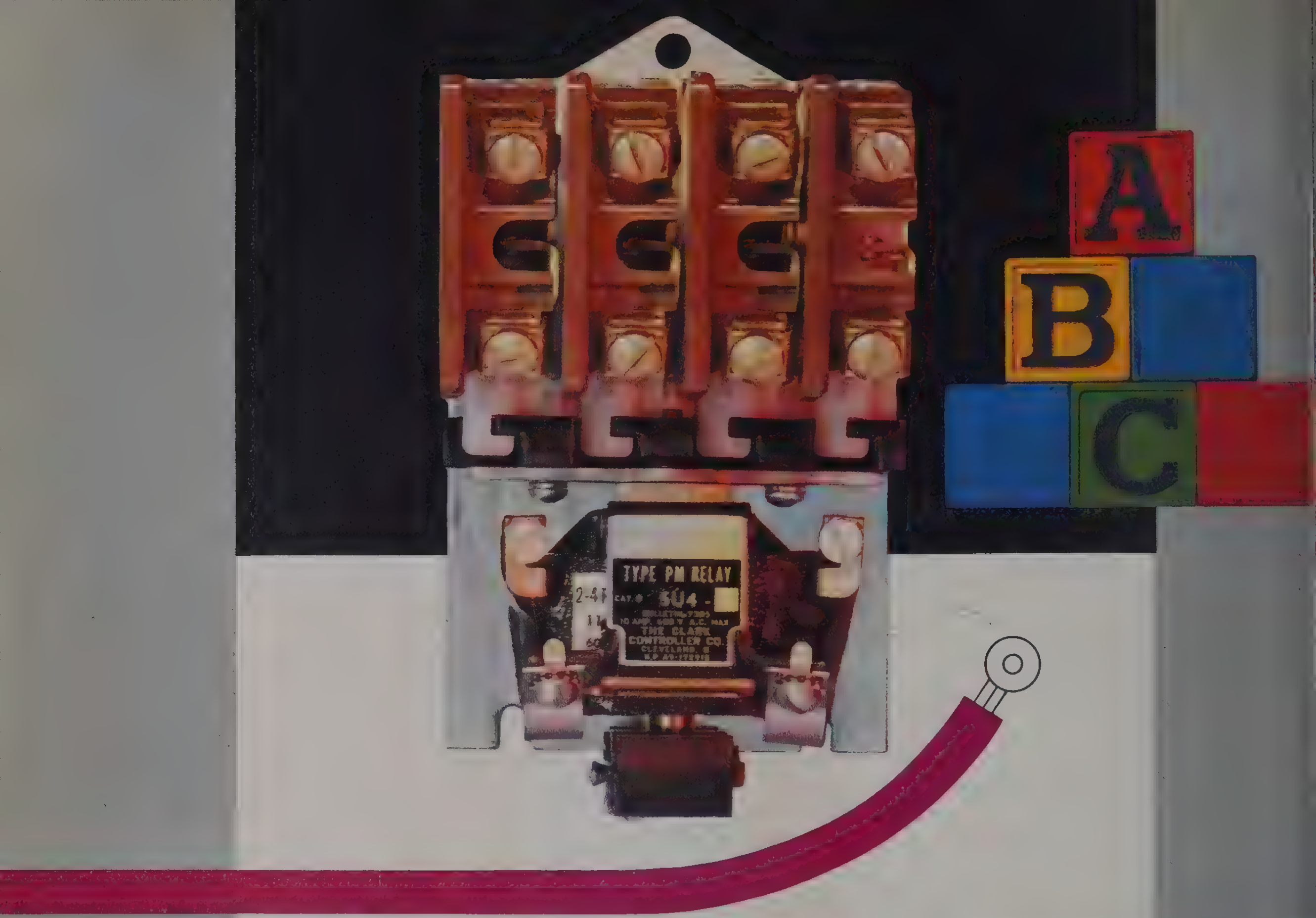
CLARK STARTERS

MORE INFORMATION? Your local Clark distributor or district sales representative will be glad to help you set up your own comparison tests. Ask for literature on the complete Clark Type "CY" Starter line, too. Or, write direct to The Clark Controller Company.



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see for yourself why...

Color-coded conversion kits help solve any relay circuit problem with building-block simplicity

New color-coding of conversion kits by function now makes it possible for relay users to take even greater advantage of the versatility and flexibility of the complete, integrated line of Clark "PM" Relays.

Basic relays are easily modified on the job with a few simple conversion kits to give you a virtually unlimited number of circuit arrangements on convertible pole, universal pole, latch and time-delay relays.

The "modular construction" of all relays in the Clark "PM" line insures integrated uniformity, compactness and flexibility. Functional alignment in mounting results in neater, more uniform panels and most efficient utilization of valuable space.

More for your money wi

CLARK RELAYS

COMPLETE INFORMATION on Cla color-selective conversion kits available through your local Cla distributor or district sales rep sentative. Or, write direct to T Clark Controller Company.

The
CLARK CONTROLLER
Company

"Everything Under Control"

Main Plant: *Cleveland 10* • **Western Plant:** *Los Angeles 58*
In Canada: *Canadian Controllers, Limited, Toronto*

(81) LIGHTNING ARRESTERS, Type F intermediate class, are illustrated in Bulletin LA4. Units described are rated from 20 through 121 kv. Line Material Industries.

(82) TRANSFORMERS. Bulletin 61B-8222B describes dry-type transformers in ratings 3 through 50 kva, single-phase, 600 volts and below. Allis-Chalmers.

(83) LIGHTING STANDARDS and accessories designed for supporting larger and more efficient luminaires for street and highway applications are covered in new Catalog ALS-5, 16 pages. Pfaff & Kendall.

(84) INSTRUMENT TRANSFORMERS for metering and related applications, rated from 2.5 to 12.5 kv and 10/5 to 5000/5 turns ratios are described in Bulletin 3-1.2, 4 pages. Associated Research, Inc.

(85) METAL FRAMING construction and maintenance handbook. New 36-page booklet gives application and installation information, specifications, and methods of attaching to structures. Unistrut Products Co.

(86) GLASS FOR LIGHTING. New 4-color brochure gives examples of recent applications of glass in lighting installations. Corning Glass Works.

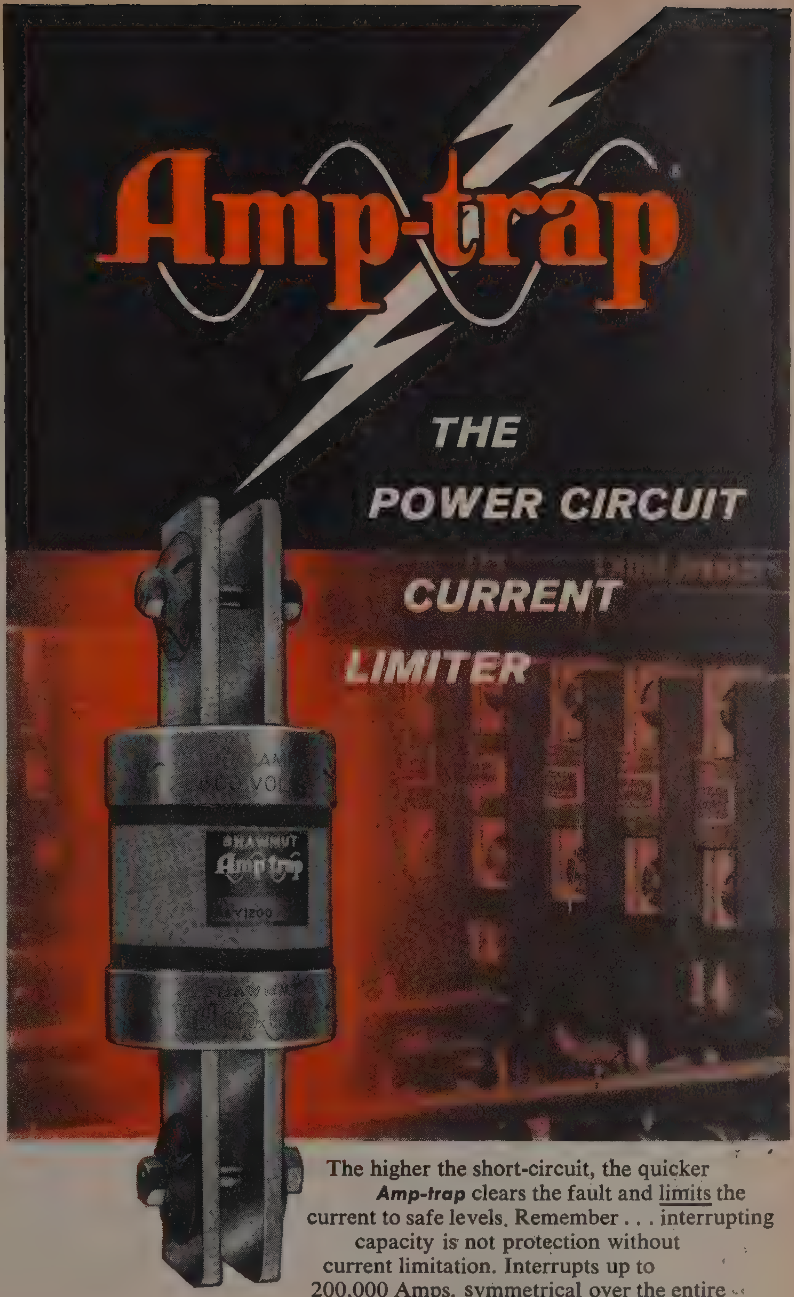
(87) AUTOMATIC SIGN CONTROL. 1-page stuffer designed to help explain and sell timing devices for neon and incandescent signs and displays describes standard and heavy-duty timers plus rain-tight case. International Register Co.

(88) ALUMINUM—how it's used in electrical conductors. New booklet answers the most-often-asked questions on the use of aluminum in electric wire and cable. Reynolds Metals Co.

(89) LIGHTING LENS. Bulletin L-122-M-1 gives complete information on new tempered square convex lens for general area lighting in such places as schools, public buildings, and security institutions. Corning Glass Works.

(90) PRECAST CONCRETE FLOOR and roof slabs—how they were used as raceways for power, telephone, signal, and other low-voltage wiring in new 10-story office building. 6-page folder. Flexicore Co., Inc.

(91) RELAYS. Bulletin ARSP-8, 4 pages, illustrates and lists over 115 general-purpose and specialty relays available from stock. Elgin National Watch Co.



The higher the short-circuit, the quicker *Amp-trap* clears the fault and limits the current to safe levels. Remember . . . interrupting capacity is not protection without current limitation. Interrupts up to 200,000 Amps. symmetrical over the entire Ampere range. Stops short circuits short. Anticipates and prevents destruction before it can occur. Faster than any ordinary fuse.

Use *Amp-trap* on all general power circuits, DC circuits, Networks, Entrance Switches, Busways, etc. Be safe, not sorry — ask for, get and install *Amp-trap*.

There is one for every purpose. Write today.

Amp-trap ® - *"Awake At The Switch"*

THE CHASE-SHAWMUT CO.

374 MERRIMAC STREET • NEWBURYPORT, MASSACHUSETTS

Subsidiary of I-T-E CIRCUIT BREAKER CO.

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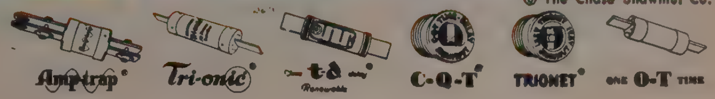
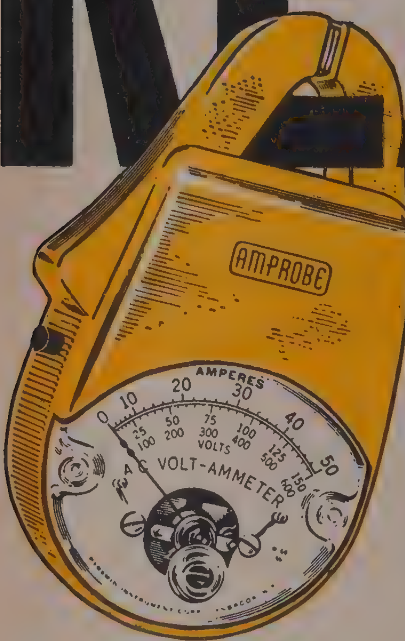


*TRADE IN YOUR OLD VOLTAGE TESTER!

READ

voltage and amperage in a snap!



A voltage "indication" doesn't give you all the information you need to do a job right. You want a precise voltage *reading*, measured on a calibrated scale... and you get it with the AMPROBE JR. But sometimes voltage is only half the story. Most jobs require an accurate *current* reading too. The pocket-size AMPROBE JR. provides it—in a snap—*without* interrupting service! Why settle for anything less?

*SPECIAL OFFER

Trade up to an AMPROBE JR. *now*. For a limited time only, we'll give you a sturdy leather case plus the AMPROBE ENERGIZER (to multiply the JR.'s sensitivity *ten times*)—an *$8 value*—for *only $1* and your obsolete voltage tester! The leads come with the JR. Snap up this offer today—at your distributor.

Amprobe Jr.®
snap-around volt-amp tester
$19.85

PYRAMID INSTRUMENT CORPORATION, LYNBROOK, NEW YORK
Serving the Electrical Testing Needs of Industry

(92) POST INSULATOR. 4-page Bulletin 1481-H illustrates and describes several sizes of insulators for horizontal mounting, suitable for application on 34.5- to 69-kv systems. Ohio Brass Co.

(93) SECONDARY BATTERIES. New 10-page brochure describes rechargeable siver-zinc Silvercel batteries. Yardney Electric Corp.

(94) CIRCUIT BREAKERS for industrial electronic systems. 8-page catalog gives information for selection of standard and miniature thermal units as well as push-pull and toggle types, 1 through 50 amps. Wood Electric Corp.

(95) MULTI-OUTLET SYSTEM. New engineering data folder describes 2-piece, all-steel raceway, including information on wire capacity, methods of fastening to various surface types, and fittings and devices. Wiremold Co.

(96) TRANSFORMERS. Bulletin GEA-6832A, 8 pages, describes full line of oil- and Pyranol-filled distribution equipment transformers, rated from 112½ to 2500 kva. General Electric Co.

(97) SWITCHGEAR. Bulletin 2801-2A, 20 pages, describes redesigned line of 4160-volt metal-clad stored energy switchgear in ratings through 3000 amps and 250 mva interrupting capacities. I-T-E Circuit Breaker Co.

(98) ENCLOSURES for circuit breakers in explosion-proof, dust-tight, and weather-proof designs are covered in Catalog 17. Killark Electric Mfg. Co.

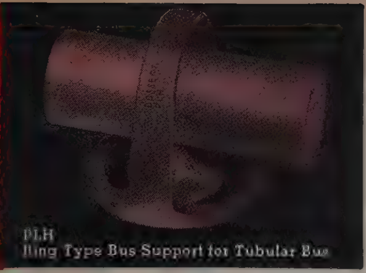
(99) ARC INHIBITORS. Bulletin 9600, 2 pages, gives electrical characteristics and dimensions of inhibitors designed to suppress arcs and absorb voltage surges on dc controllers. Square D Co.

(100) ALUMINUM CONDUIT. Physical properties and performance factors of rigid aluminum conduit are compared to steel conduit in indexed charts, tables, and text in new 32-page manual. Kaiser Aluminum & Chemical Sales, Inc.

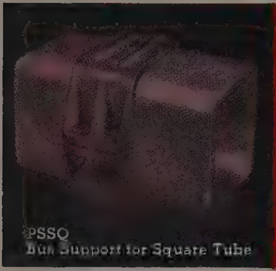
(101) FLUORESCENT LIGHTING. 4-page brochure describes new and complete lines of Slimline and Strip Line fixtures. Moe Light Div. Thomas Industries Inc.

(102) BALLAST GUIDE, ATC-110, includes complete listings on thermally protected, weatherproof, and SHO, VHO, and Powergroove ballasts. Advance Transformer Co.

RUGGED


PLH
Ring Type Bus Support for Tubular Bus

SBC
Sliding Bus Support for Tubular Bus


PSSQ
Bus Support for Square Tube

HPS
Hook on type Bus Support Clamp for Tubular Bus

CS
Bus Support Clamp for Cable

PSS
Tubular Bus Support Clamp

SHV
Vertical Bus Support Clamp for Flat Bar

SAV
Vertical Bus Support Clamp for Flat Bar

DOSSERT HIGH-STRENGTH BUS SUPPORTS

- Higher cantilever strength
- Higher impact resistance
- Higher corrosion resistance
- Greater durability

These Dossert Bus Supports are made of a high tensile strength cast bronze alloy and are equipped with silicon bronze bolts and nuts, making the entire unit completely non-magnetic. Available for all sizes and types of busses. Dossert Bus Supports can also be furnished in Coupling, Tee Connecting, Elbow Connecting, Tee Coupling and Expansion Connection types.

Special fittings and modifications can be readily supplied on short notice.

50 YEARS OF TECHNICAL KNOW-HOW

DOSSERT MFG. CORP.

249 Huron Street, Brooklyn 22, N. Y. • Representatives in all principal cities
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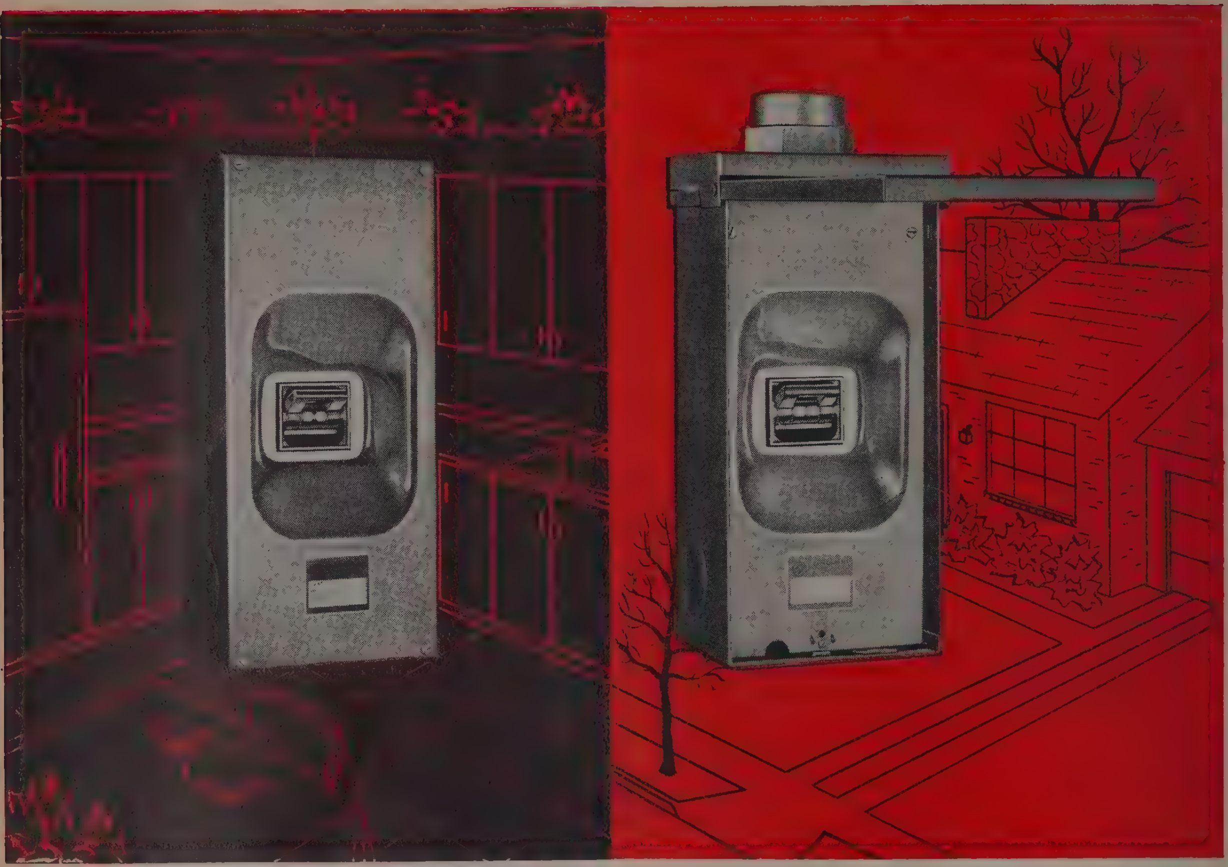
NEW SERVICE ENTRANCE EQUIPMENT



200-AMP CAPACITY . . . CIRCUIT BREAKER CONVENIENCE . . . AT A COMPETITIVE COST

You will like the extra convenience of Heinemann's new 200-amp service entrance equipment . . . and so will your customers.

Trim, compact, smaller than comparably rated fused pull-outs, these units offer considerable savings in terms of easier installation and more efficient operation.

Installation features would make an apprentice happy. Wiring space is plentiful . . . connections are easily made with solderless screw-type connectors . . . knockouts are placed so that you can run-in conduit from any angle.

Completely non-thermal, the *magnetically* actuated Heinemann circuit breaker eliminates nusiance tripping and other temperature-caused troubles. You can therefore locate the unit wherever most convenient . . . next to heat lines or out in the hot sun, if necessary. The breaker will always carry full rated current, will always trip as specified.

Breaker protection provides other conveniences as well: no bothersome fuse changing, simplified switching: the switch handle has only two positions: ON and OFF. No reset position; no confusion possible.

Rated at 120/240V AC, two or three wire service, the new Heinemann service entrance equipment is available in outdoor or indoor enclosures. Both are of heavy-duty steel in a grey baked enamel finish. Outdoor enclosures are raintight, with hinged covers that may be padlocked against tampering.

You'll be pleasantly surprised by the cost. It's little more than that of comparably rated fused equipment.

For full information send for Bulletin 1003

HEINEMANN
ELECTRIC COMPANY
132 Plum Street, Trenton, N. J.

Circuit breakers

S.A. 1059

Reader's Quiz

QUESTIONS from readers on problems of industrial equipment, installations, maintenance and repairs. Answered by electrical maintenance engineers and industrial electrical contractors out of their experience. For every question and every answer published we pay $5.00.

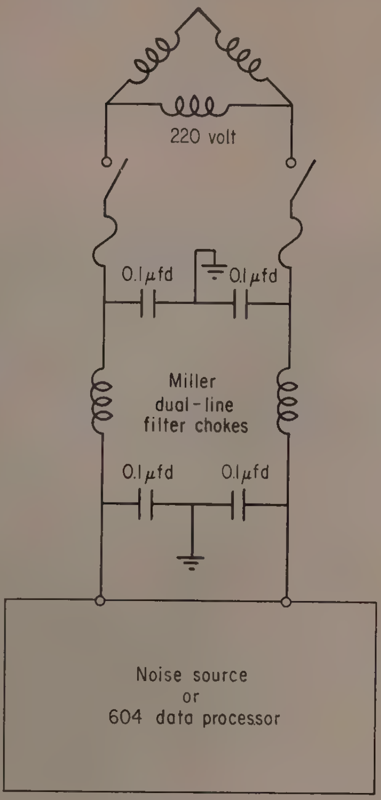
Data Processing Machine Supply

QUESTION E38—Our two IBM-604 data-processing machines have been making errors which we feel are due to the power supply. The 220-volt single-phase service for the machines are taken from a 3-phase, 220-volt ungrounded-delta substation. An oscilloscope placed across the input to the IBM machines shows occasional spikes of very short duration and 50 volts or more in magnitude. We have been unable to locate the source of this "noise" because of its infrequent nature. I would be interested in knowing what other readers have been using for data-processing machine supplies, and also whether or not a band-pass or low-pass filter network would work for this application. If so, how would you design the parameters?—I.G.B.

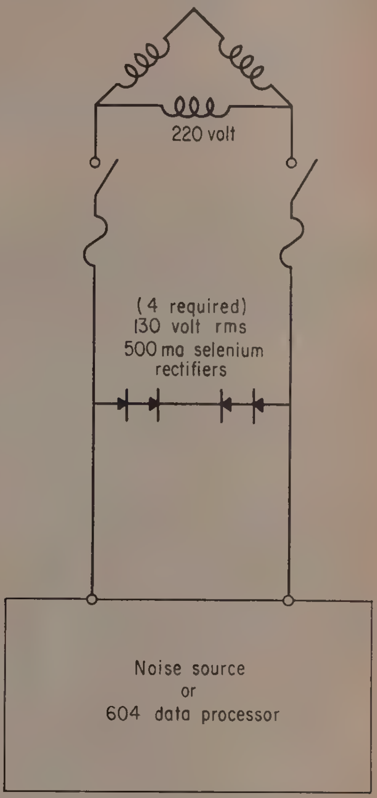
ANSWER TO E38—We have two IBM calculating machines and had the same trouble that I.G.B. describes. Our machines were connected to a 4800/208-volt, 3-phase, 60-cycle transformer. They both were connected to the same electrically operated substation breaker, but each was protected by an E frame. 277-volt, plastic-type breaker. The breakers seemed to be very hot, indicating poor contact pressure. We also suspected that there was some arcing that caused the voltage transients.

We replaced the plastic breakers with fused disconnects and have had no trouble since.—H.E.H.

ANSWER TO E38—Try a harmonic-free constant-voltage transformer, if you are sure that all the tubes or transistors, condensers, and resistors are not at fault. These machines are some forms of amplifiers which use a dc filtering system, so that the 50 or more short voltage spikes will not pass a good filtering system. The filament voltage is also protected. but if IBM insists on perfect voltage and expects you to improve the input voltage and current, then I would suggest that you check the input voltage and current of all machine parts to see if the machine has to be serviced every five years or more often.—H.S.



Oscillatory noise



Single "Spike" noise

ANSWER TO E38—One of the fundamentals in noise suppression is the suppression or elimination of the noise at the source. Every effort should be made to locate the source of the noise. A portable radio may help in this regard as a noise locator.

One possibility that should not be overlooked is that one data processing machine or associated components may be producing the noise.

If the noise source can be located, and if oscillatory in nature, then LC low-pass filters should be inserted in the line as close as possible to the noise producer.

If the source cannot be located then LC low-pass filters should be inserted in the line to each 604, again as close as possible to each machine.

Miller dual-line filter chokes D7829, rated at 30 amps, may be used if they can handle the 604 load, together with 1/10 microfarad 600-volt oil-filled condensers, to make experimental filters.

Commercial radio interference filters are available from Filtron Corp., Flushing, N. Y., and All-Tronics Inc., Westbury, L. I.

If the noise is a single spike, not oscillatory, an experimental peak suppressor may be made up of several selenium rectifiers, back to back, across the line. Commercial suppressors are available from Bradley Laboratories, New Haven, Conn. See sketches above.—J.B.

Starting Synchronous Motors

QUESTION F38—In our plant we have a 40-hp, 2300-volt, 3-phase, 60-cycle synchronous motor, excitation 110 volts. This motor drives an ammonia compressor and it has automatic synchronizing equipment.

When we start this equipment, it turns over and has a heavy growl. It accelerates in speed, growling and vibrating continuously. In about

Mr. Jerry Shaw of Shaw Electric, electrical contractor for Justice Elementary School, Justice, Illinois, says:

"Honeywell helped us install Central Security System

Mr. Jerry Shaw, in one of the classrooms in Justice Elementary School. Automatic detectors in the classroom will detect fire without fail and immediately ring alarms in the building and at the fire station.

our first without a hitch"

Honeywell planned the system for Justice Elementary School down to the last detail—then supervised its installation and checked it out to make sure it operated perfectly.

"This was our first attempt at installing a Central Security System," says Mr. Shaw. "And with Honeywell's help, it went off without a hitch. Honeywell engineers saw that the equipment was delivered on schedule and not only supervised the installation, but stayed on to check it out."

The Honeywell Central Security System in Justice Elementary School protects the building against both fire and vandalism. Twenty-two automatic fire detectors are located throughout the school. They detect fire when it breaks out and automatically sound alarms to clear the building and notify the fire department.

The system also includes Honeywell intrusion detectors, installed at key locations in the building. They detect intrusion and automatically sound an alarm at police headquarters. In addition, the system provides intercommunication between the school and police headquarters to enable the police to listen for suspicious noises.

You'll find your job always goes smoothly when you work with Honeywell. Help is conveniently available from any of the 112 offices across the nation. Call your local Honeywell office. Or write Honeywell, Dept. EC-9-150, Minneapolis 8, Minnesota. In Canada, write Honeywell Controls, Limited, Toronto 17, Ontario.

Mr. Joseph M. Stimatz, Chief of the Justice Fire Department, operates the Honeywell Central Security Panel at fire and police headquarters. Both fire and intrusion will automatically be reported here so that help can be dispatched without delay.

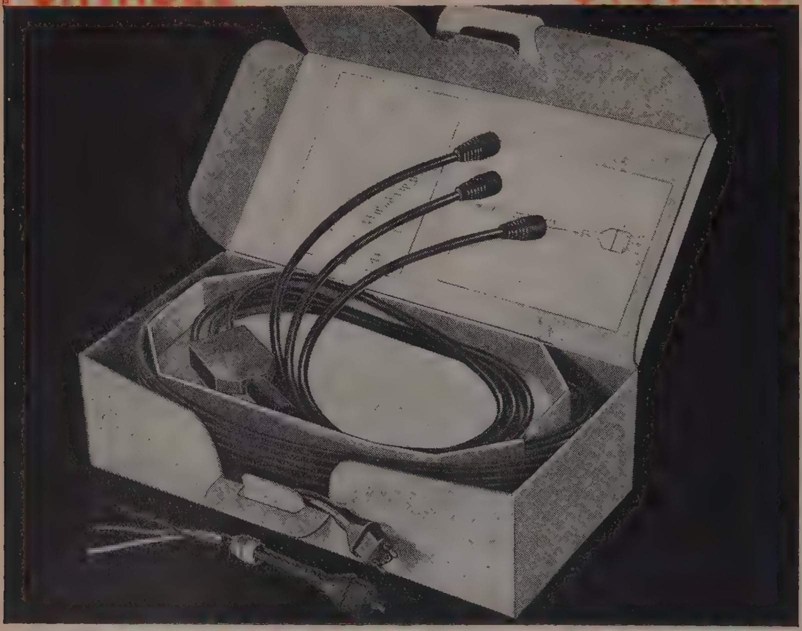
Honeywell

First in Control

SINCE 1885

th
PIONEERING THE FUTURE
YEAR

PORTABLE Power Distribution SYSTEMS



offer GREATER SAFETY • CONVENIENCE

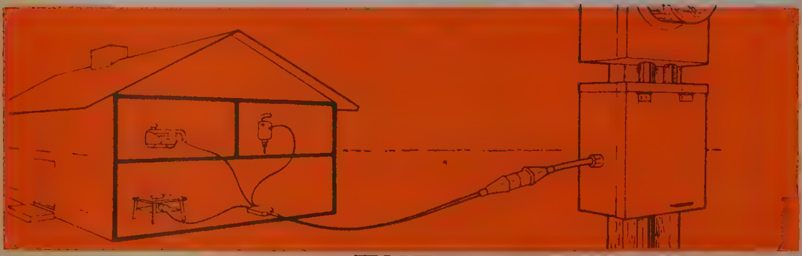
WB TUFFLINE Power Systems carry electric power from temporary service or portable generators wherever needed at construction sites.

These systems are made of rugged 3 conductor DYNAPRENE SO cord permanently molded to tough, waterproof neoprene connectors.

Extensions are available so that additional length and additional outlets are obtainable.

Write for complete details in Bulletin TL-2 . . . it's free.

. . . TO CONTRACTORS



TUFFLINE DIVISION

WB WHITNEY BLAKE CO.

New Haven 14, Connecticut • Telephone: CHestnut 8-5515 . . . TWX NH84

five minutes after starting, it reaches 92% of synchronous speed and latches in and runs without a growling noise. The air gap is 0.055 and symmetrical throughout. The motor has 0.015 whip.

Can someone tell us what is wrong with this motor?—C.P.

ANSWER TO F38—Assuming that this synchronous motor, which incidentally is a very small motor of the synchronous design, was designed and is adaptable for this ammonia refrigeration application, requiring exceptional high-starting, pull-in- pull-out torques, C.P. should first check into the electrical components, such as automatic unloader, automatic by-pass valve, capacity control, because any of these automatic controls impaired or inoperative could be the cause of the long five agonizing minutes of growling and vibrating to bring this motor and compressor up to speed. In the event the above mentioned items check out OK and with the air gap symmetric and only 0.015 whip, which stems from the reciprocating action of heavy ammonia compressor, you should then check into the increment-starting, star-delta starting equipment whichever may be the case. And last but not least, check into the amortisseur winding, because synchronous motors are not considered self-starting, and any small defect in the above could delay bringing the rotor nearly up to synchronous speed at which point then dc current is automatically applied and the motor pulls into synchronous speed.

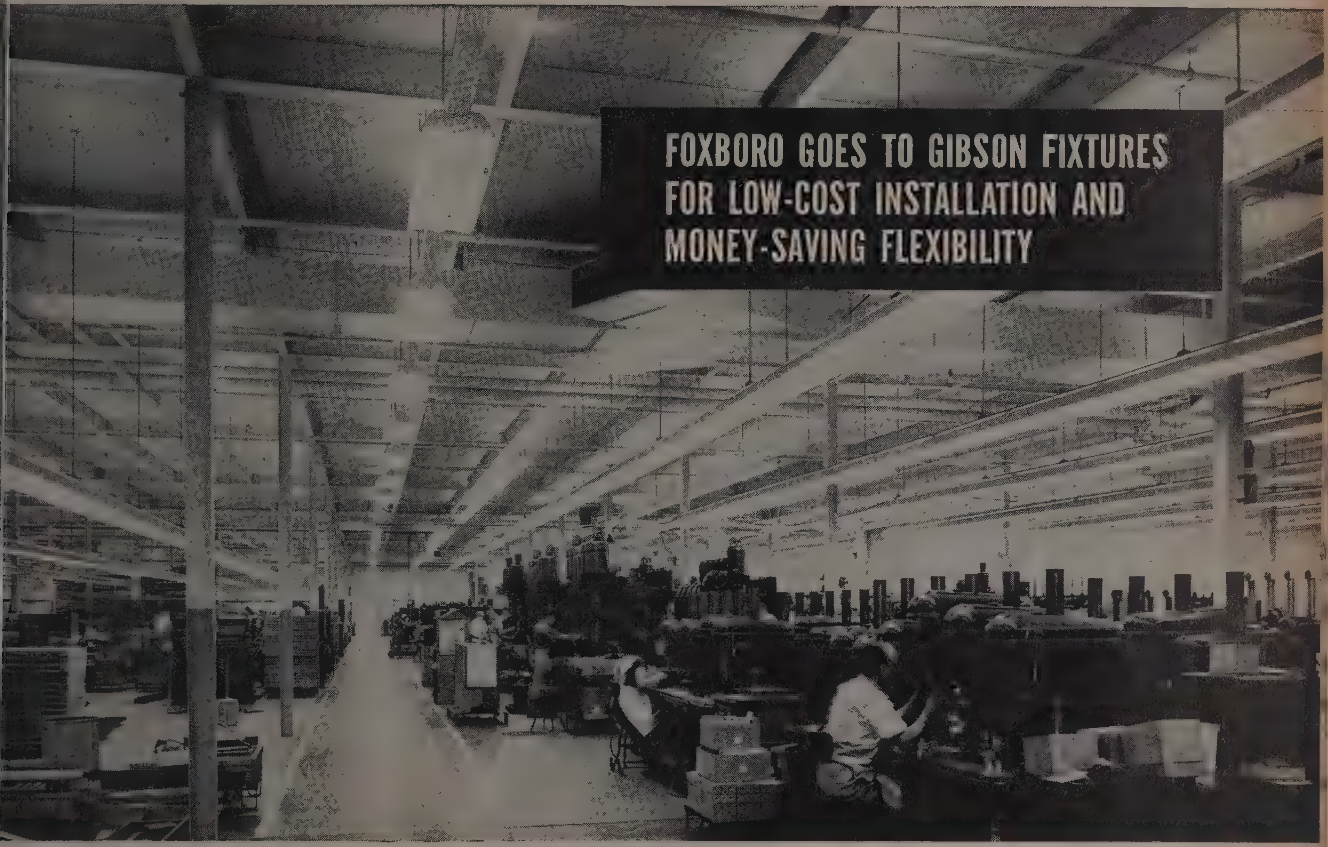
However since there is so much at stake, you should consider calling in the service engineer of the electrical equipment.—C.B.

ANSWER to F38—In starting compressor loads, whether using synchronous or induction motors, there should be some form of unloader on the compressor which will allow the motor to accelerate to full speed within seconds before applying the compressor load.

Five minutes is entirely too long for any motor to growl and vibrate in attempting to get up to full speed. If you are sure that there is not an unloader on the machine, or it may be inoperative or never hooked up, then contact your compressor manufacturer for information as to the correct method to tie one in to the compressor.

An unloader merely provides a by-pass between the suction and discharge sides of the machine, pre-

Gibson Fixtures Give You More Than Good Lighting . . . Much More!



FOXBORO GOES TO GIBSON FIXTURES FOR LOW-COST INSTALLATION AND MONEY-SAVING FLEXIBILITY

t: Korslund, LeNormand & Quann, Inc. / Electrical Engineer: Edwin L. Steinbrenner / Electrical Contractor: Hixon Electric Co. / General Contractor: Vappi & Co., Inc.

"Gibson lighting fixtures offer distinct advantages in installation and maintenance," reports an official of The Foxboro Company which uses Gibson fixtures throughout its new assembly building.

"Our Gibson fixtures," he says, "were installed faster and at lower cost than any others we have used. The fact that these fixtures can be plugged in and un-plugged like an electric appliance means that they can be quickly re-spaced to accommodate changes in plant layout and can be dismounted instantly for servicing without distracting production workers."

Write for descriptive literature today.

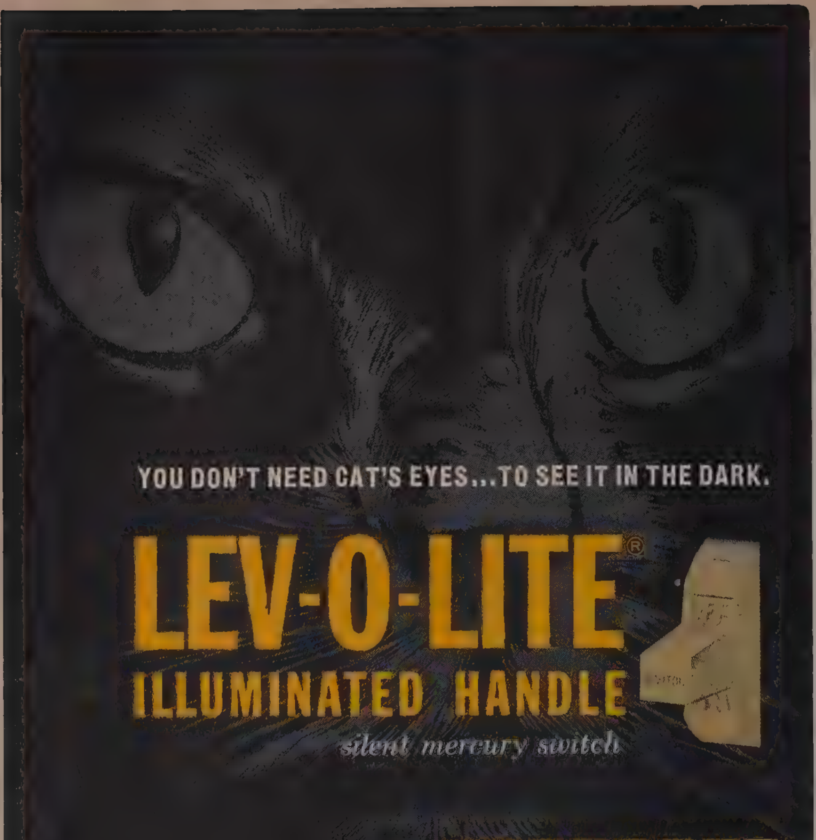
Gibson
LIGHTING

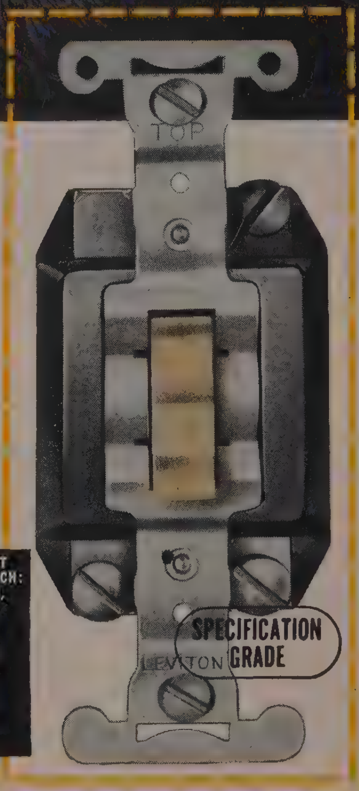
Makers of
THE FIXTURES
THAT JUST
"PLUG-IN"
PAT. PENDING

COMMERCIAL, TROFFERS, INDUSTRIAL

GIBSON

GIBSON MANUFACTURING COMPANY
1919 Piedmont Circle, N. E., Atlanta 9, Georgia





No more fumbling in the dark . . . no more dirty walls from "switch-groping." Instead, a tiny, built-into-the-handle neon lamp that always remains bright, lasts a lifetime, and costs but a few cents a year to operate! This switch is sturdy, easy-to-install, with no moving parts to wear out, no springs to snap. Ideal wherever silence is essential . . . now popularly priced for every installation.

And . . . it's just one of the many fine, economical devices made available to everyone through the superior skills and complete resources of LEVITON!

For the complete story, write today on your letterhead.

All silent switches listed by U. L. and C. S. A.

LEVITON SILENT MERCURY SWITCH: Fully enclosed, rated 10A.-125V.T, 5A.-250V. Ivory toggle with illumination. Single Pole No. 5561 or Three Way No. 5563

Available boxed or carded. Specify "K" when ordering on card.

Your best jobs are done with . . .

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LEVITON MANUFACTURING CO., INC., BROOKLYN 22, N.Y.

Chicago • Los Angeles • Leviton (Canada) Limited, Montreal

For your wire needs, contact our subsidiary AMERICAN INSULATED WIRE CORPORATION

venting compression until the motor has had time to accelerate to full speed.

An auxiliary contact on the field-applying contactor may be used to operate the unloader, usually a solenoid valve; or a time-delay set to operate just after synchronization will also suffice. In either case, the unloader should be energized at the same time the motor is started and then tripped off after full speed is attained, allowing the compressor to start pumping.

If starting is infrequent and non-automatic, a hand-operated valve could be used for the unloading.—R.M.K.

ANSWER TO F38—I have found the same symptoms on several synchronous motors. If you will dismantle the motor and inspect the squirrel-cage winding on the field piece (rotor) you will probably find that the end ring is not fastened to the winding properly, either welded or bolted.

This is usually caused by an excessive overload or a prolonged starting period.

I hope that this information will help answer your question and cure your problem.—W.B.W.

Lamps for Temporary Lighting

QUESTION G38—I would appreciate the opinion of others as to whether it pays to use "rough-service" lamps on temporary lighting of buildings under construction.

Strings of lights are sometimes moved around, and water often drips on the bulbs. Vibration and wind can also enter into the problem.

Rough-service lamps usually cost at least twice as much, and they are not quite as efficient in the amount of light they give.

I have used both kinds, but still cannot answer the question as to which is the better method.—M.C.T.

ANSWER TO G38—We have made many lengthy and profitable tests along this line and arrived at these facts.

Special long-life lamps give up to 500% longer life than the so called "rough-service" lamps of three other leading lamp manufacturers, while the lumen output remains very steady and approximates the lumen output of other standard lamps.

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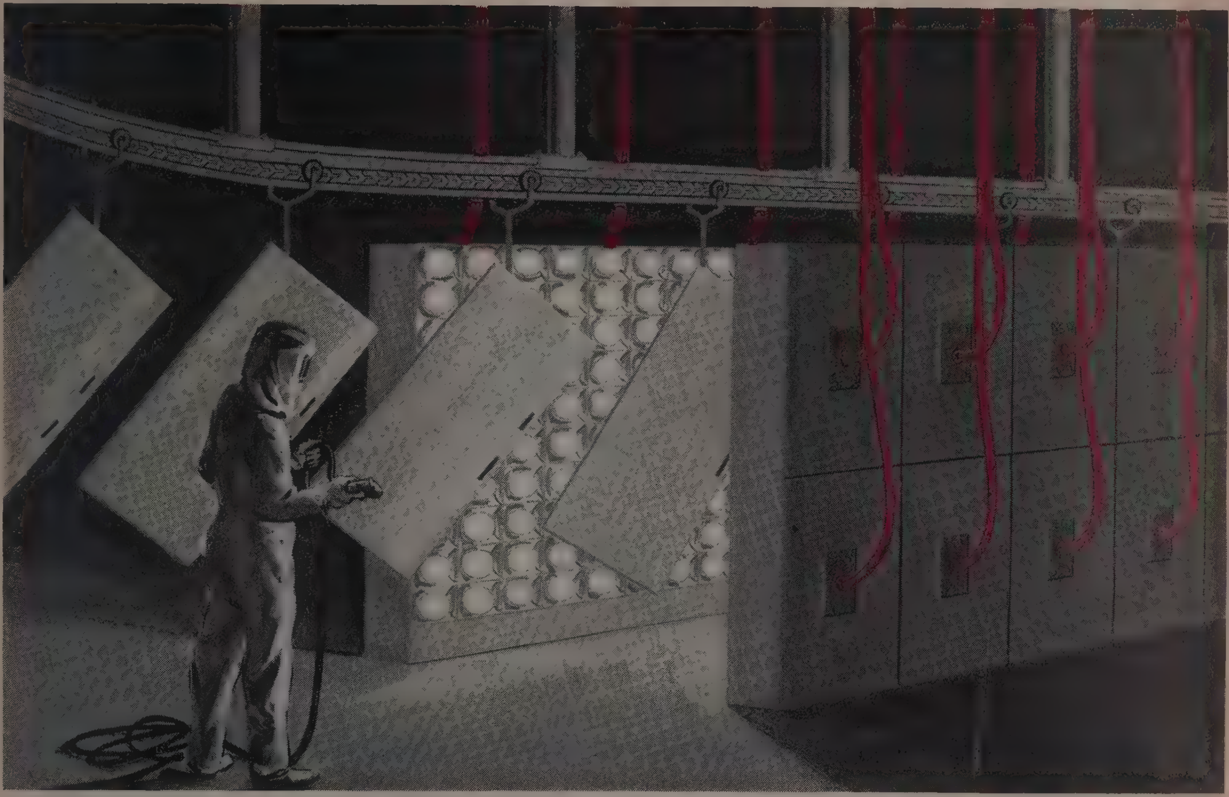

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You can eliminate the extra expense of stocking many specialty wires and cables. How? By specifying Silastic®, the Dow Corning silicone rubber.

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Leading manufacturers now offer power cable, control cable, hookup wire, fixture wire and building wire with insulation of Silastic.

TYPICAL PROPERTIES OF SILASTIC FOR WIRE	
Temperature range, °F	—130 to 500
Insulation resistance, megohms/1000 ft.	1000 to 3000
Electric strength, volts/mil	300 to 500
Dielectric constant, 10^2 cycles per second, nominal	3.2

For new booklet on how to save with Silastic insulated wire and cable and list of suppliers, please address Dept. 2809.

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The fact that the cost of the lamp is higher, really, is only a small part of the picture. The time and labor necessary to replace the lights is the expensive part (in this country, that is) so when you have to replace the "rough-service" type four to five times as often as the long-life the answer is obvious, and our experience has proved it.—H.N.W.

ANSWER TO G38—There are many facets to your question. I would say that in general for use on extension cords or in any service where excessive shocks may be encountered, rough-service lamps should be used. But, we have found that on many construction jobs we had far superior results with rigidly mounted sockets and used PAR and R bulbs that are resistant to breakage from rain or snow. Rigid mounting eliminates the vibration. Give this a try.—J.A.M.

ANSWER TO G38—It is my opinion that it ordinarily does not pay to use "rough-service" lamps for temporary lighting of buildings under construction for the following reasons:

1. As M.C.T. states, "rough-service" lamps usually cost twice as much as ordinary lamps and are not as efficient from a lighting standpoint as standard lamps.
2. "Rough-service" lamps are sometimes hard to obtain and, even when purchased in a very large quantity on a wholesale basis, the savings would not start to compare to standard incandescent lamps at wholesale prices.
3. The replacement factor may or may not be greater for standard lamps, depending on (a) environment, (b) voltage used on the lamps.

Under the conditions of operation stated by M.C.T., I cannot see where "rough-service" lamps would justify their added costs.—E.J.M.

Can You Answer These QUESTIONS?

QUESTION P38—In our plant we have 220- and 440-volt, 3-phase delta ungrounded circuits for conveyors. These circuits have a static voltage that builds up to the circuit voltage on all three lines. What do you recommend to keep this static voltage off of the lines? It is harmless except when making tests on circuits when they are hot.—C.H.K.

QUESTION Q38 — For a special fluorescent cove-lighting system, the ballasts should be located remote, on a wood wall. Can they be mounted directly on the wall, or do the ballasts have to be enclosed in a sheet steel box? How big should the box be to enclose two single-lamp ballasts? The lamps are 40 watt, rapid start, G.E. No. F40/WWX; the ballasts are G.E. No. 89G325, low power factor.—J.A.

QUESTION R38—A feed mill is served with a 3-wire, 3-phase, 480-volt ungrounded type of service from a bank of three 50-kva transformers connected wye-delta with a floating neutral on the high side. Trouble developed such that the 3-phase, 440-volt motors would not run although the few small 115-volt single phase motors and lights did work. They were served from a 440/110-volt single-phase dry-type transformer located in the building.

Voltage readings at the service disconnect switch were roughly 480 volts between all phases, except that when an attempt was made to start a 3-phase motor, one phase would drop to almost zero. The voltage readings to ground were extremely unbalanced, one phase wire to ground causing the voltmeter to slam against the peg on the 750 volt scale, and after several readings flashed over on the inside of the meter.

Continued investigation revealed that a terminal on the end of a coil on the low-voltage side of one of the 50-kva transformers had burned open inside of the transformer. This terminal was reconnected and everything went back to normal.

Where did the high voltage come from between one leg and ground that burned out the voltmeter?—R.B.F.

QUESTION S38 — We have been told that motors that have epoxy encapsulated windings cannot be stripped for rewinding in case of winding failure. If this is the case, then how are these motors rewound? We would greatly appreciate any discussion on this subject, as we now have many motors with epoxy encapsulated windings and are in the throes of purchasing more.—J.A.M.

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USS Tiger Brand Armorlokt cable in open racks costs less to install, carries more power and can be easily maintained.

Power for new refinery supplied by overhead installation of USS Tiger Brand Armorlokt Cables

Electrical power for this highly automated refinery of the Standard Oil Company (Ohio) at Toledo, Ohio comes into the transformers at 69,000 volts and is stepped down to 4,160 volts for the various power feeders. These are carried to unit substations of the processing plant on racks supporting the USS Tiger Brand Armorlokt Cable. At the substations, the voltage is reduced to 440 volts and from there is run to the starter racks for motors which drive the process pumps.

This is the first time that armored cable has been used in any of Sohio's refineries. The initial cost was less than for a conduit or concrete duct installation in the ground. The cables in air have a higher current carrying capacity for a given size cable. Since heat can dissipate quickly, a smaller cable can be used to carry the same power.

Less costly construction was possible at substations because the Armorlokt Cable was easily accessible from overhead and did not require the construction of conduit openings in a concrete ground slab.

Flexibility. Besides ease of installation, USS Tiger Brand Armorlokt Cable can be readily run around obstructions, because of its flexibility. Capacity can be quickly and economically added for future needs for more power.

Why not investigate USS Tiger Brand Armorlokt Cable—not only for new installations but for bringing old systems up to date with the least cost for installation. Write or call American Steel & Wire, 614 Superior Ave., N. W., Cleveland 13, Ohio.

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Substation showing cable racks supporting USS Tiger Brand Armorlokt Cable with varnished cambric insulation. Sizes include cables of 500 MCM with voltages of 5,000 and 600 volts.

New Standard Oil Company (Ohio) refinery at Toledo, Ohio with a capacity to process 60,000 barrels of crude oil per day. Engineers and constructors: The M. W. Kellogg Co., Electrical Contractors: W. W. Clark Corp.

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Questions on the Code

Answered by:

B. A. McDONALD, *New York Board of Fire Underwriters, Rochester, N. Y.*
B. Z. SEGALL, *Consulting Electrical Engineer, New Orleans, La.*
R. E. WARD, *Chief Electrical Inspector, Insurance Department, State of Tennessee, Nashville, Tenn.*

Service Installation—Multiple Occupancy

Q. *Please advise me of your interpretation of the code in this situation.*

Location of service entrance switch.

Building is a one story taxpayer, fireproof.

Location of meter equipment: basement (not used for entrance or exit).

Boiler room is used by dry cleaner and laundry.

Beauty parlor, luncheonette-toy store do not use basement and are the only ones with an entrance from store to basement.

Sewer line crosses entrance door at bottom of stairs about one-third from top.

Switch location was installed outside in enclosure because no room is available inside.

The question is, does switch have to be raintight under these circumstances?

Diagram is shown below for explanation.—H.W.

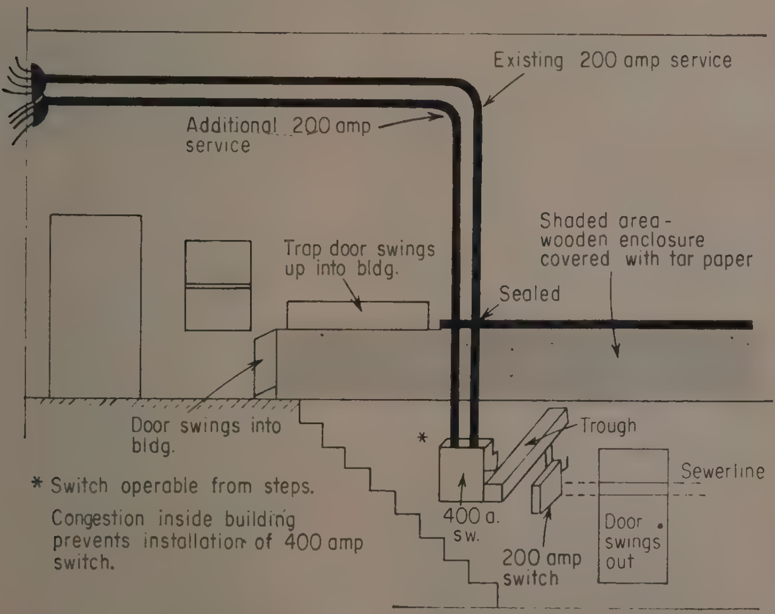
A. A review of the illustrations submitted indicates that the new 400-amp, 3-phase, 4-wire service switch has been installed in an outside stair-well leading to the basement in the building. It is enclosed by a wooden structure with tar-paper roofing. Access to the stair-well is through door openings leading into some of the stores. The structure is a one-story multiple-occupancy building serving four stores. Access from the stair-well to the basement is through a door opening, partially obstructed by a sewer line located one-third the length of the door from the top of same. Customer's metering equipment and his individual disconnect are located in the basement. We have used only one of the illustrations submitted to cover the details involved.

The specific question raised concerns the new 400-amp main switch. Should it be raintight? As covered by code definition, should it be "So constructed or protected that exposure to a beating rain will not result in the entrance of water."

Since the switch is installed in a stair-well, which is totally enclosed, it is quite obvious that it will not be exposed to a beating rain. As a result, it appears that a raintight switch is not required by the code. If the outside wooden structure enclosing the stair-well does not adequately deter the entrance of water and snow, we may have a damp location, but I doubt if it would be classified, as defined by the code, as a wet location. Section 380-4 requires a switch located in a wet location to be enclosed in a weatherproof enclosure or cabinet. If it is considered to be a damp location the provisions of Section 373-2 apply. Such conditions may only be properly determined by the authority enforcing the code in line with existing circumstances.

Another factor which could enter the picture concerns the local building code which may not permit the 400-amp switch to be located in the stair-well. Since the basement is occupied by the dry cleaner and laundry there could be a question with respect to local exit requirements, and the sewer line located directly in the path of exit may likewise be subject to criticism. Perhaps there should be a door on the enclosure leading directly to the outside. Such questions are beyond the scope of the code, and the building inspector should be consulted.

In addition to the above comment, the provisions of Section 230-75 require each occupant, in a multiple occupancy building, to have access to his disconnecting means. When access is only available through another tenant's occupancy, a question immediately arises with respect to this code rule. Is there an agreement whereby each occupant will have access to his meter, disconnect and overcurrent devices located in the basement? If not, there appears to be a code violation. —B.A.McD.—9/60/1


Existing 200 amp service
Additional 200 amp service
Trap door swings up into bldg.
Shaded area - wooden enclosure covered with tar paper
Sealed
Trough
Door swings into bldg.
*
Sewerline
400 a. sw.
200 amp switch
Door swings out
* Switch operable from steps.
Congestion inside building prevents installation of 400 amp switch.

Fluorescent Lighting Fixtures

Q. *Will the code permit fluorescent lighting fixtures on 50-amp circuits?—J.D.B.*

A. No. Section 220-21a states that lampholders, when connected to circuits having a rating of over 20 amps shall be of the heavy-duty type. In the 1956 National Electrical Code under Section 3114 a new definition of heavy-duty lampholders was given. This new definition establishes the limi-

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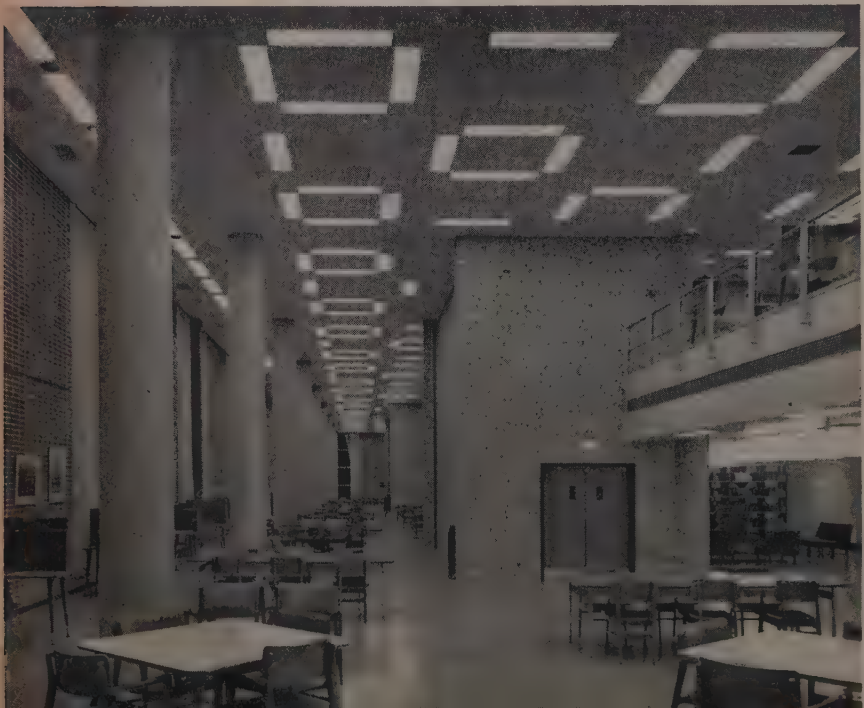
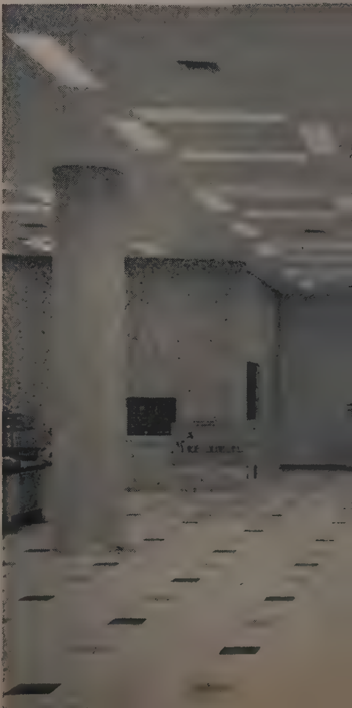
Day-Brite Troffers with Cleartex® Plastic Lens Panels deliver 73 footcandles of illumination to reading areas.





Architect and Engineer: Leo A. Daly • Electrical Contractor: Sachs Electric Corp.

How Day-Brite lighting "sells" reading in the new Pius XII Memorial Library

From the architect's first draft to the final choice of curtains, St. Louis University's modern new library was planned with one goal in mind: to encourage students to *use* it.

Self-service, open-type book shelves were used to invite "browsing" among the stacks. "Wide-open" interior design helped create a pleasant atmosphere. In addition, comfortable bright-colored furniture was contrasted against light-colored walls and a noiseless cork floor.

Lighting, of course, was a major consideration. It had to facilitate reading and, at the same time, add to the over-all cheerfulness. Day-Brite lighting was specified for high-level, high-quality illumination and clean, modern fixture design.

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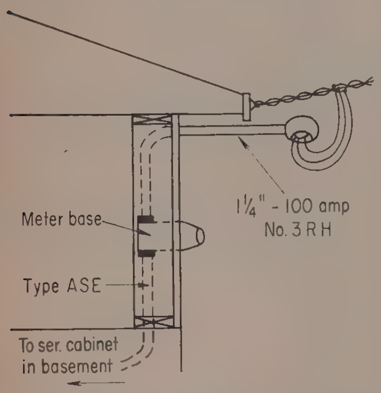
tation of fluorescent lamps to 15- and 20-amp branch circuits. In this new definition a heavy-duty lampholder is one rated at 750 watts and over. Fluorescent lampholders are rated at 600 watts or less, therefore can only be used on 15- or 20-amp circuits.

There is an exception to this rule in the use of the admedium lampholder which is used on mercury lamps, such being called heavy-duty lamps.—R.E.W.—9/60/2

Concealed Service Entrance Conductors

Q. *In a city that I had the opportunity to visit this past summer I saw dozens of homes in a newly established sub-division with service entrances installed as shown in the diagram below.*

As indicated in the diagram, the homes are wood-frame construction. Service conduit is run concealed between 2 by 4 studs to meter base. From meter base to service cabinet Type ASE cable is used.



I am very interested in your comments of such an installation insofar as the NEC is concerned.—R.C.M.

A. The provisions of Section 2331 (230-44, 1959 Code) read as follows:

"Installation of Service Entrance Conductors.

"230-44. Wiring Methods. Service entrance conductors extending along the exterior, or entering buildings, may be installed as separate conductors, in cables approved for the purpose, or enclosed in rigid conduit, or, for circuits not exceeding 600 volts, in electrical metallic tubing or as busways.

"Fine Print Note. Service entrance conductors should not be run within the hollow spaces of frame buildings unless provided with overcurrent protection at their outer end."

This rule has been in the code for more than 20 years, and at times has been the source of considerable controversy, due to the fact that the fine print note implies that service entrance conductors may be run within the hollow spaces of frame buildings, regardless of overcurrent protection at their outer end. The use of the word "should" denotes permission of a procedure which is not required. It also implies that service entrance conductors could be run in the hollow spaces of masonry construction without any consideration of overcurrent protection at their outer end.

Some inspection authorities, however, contend that such procedure is in conflict with the provisions of Section 2351 (230-70) which require the service disconnecting means to be located at a readily accessible point nearest to the entrance of the conductors, either inside or outside the building wall. In connection with this requirement, the 1959 Code calls our attention to the provisions of Section 230-45 which read as follows:

"Conductors in conduit or duct placed under at least 2 in. of concrete beneath a building, or buried in 2 in. of brick masonry or in concrete within a wall, shall be considered outside the building."

On the basis of the foregoing rules, some inspectors have refused to accept the procedure shown by the illustration. They contend that the installation of unprotected service entrance conductors, run for a distance of 10 or 15 ft within the hollow spaces of frame buildings, with an additional run of 5 ft or more exposed in the basement, is quite beyond the scope of safeguard intended by the code. They quote the provisions of Section 230-45 (old 2302), coupled with Section 230-70 (2351) as evidence in support of their convictions. They are unable to understand the logic which recognizes the need of a service switch and overcurrent device located at a readily accessible point nearest to the entrance of the conductors, and a rule which would permit 10 to 20 ft or more of unprotected conductors running to such service equipment.

Regardless of the foregoing opinions, an Official Interpretation No. 142 was issued about 1940 which reads as follows:

"Concealed Service-Entrance Conductors.

"Question 1. Does Section 2331, or any other section of the National Electrical Code, prohibit the installation of Type SE service entrance cable concealed in the hollow spaces of frame buildings?

"Finding: No.

"Question 2. Does the fine print note of section 2331 also refer to Type SE service entrance cable?

"Finding: Yes."

While the foregoing interpretation only covers service entrance cable, it appears quite evident that any of the wiring methods recognized by Section 2331 could be installed as shown on your diagram. As a result there appears to be no code violation with the installation under discussion with one exception which concerns the provisions of Section 2337 (230-51) which read as follows:

"To prevent the entrance of moisture, service entrance conductors shall be connected to the service-drop conductors below the level of the service head or the termination of service entrance cable sheaths." —B.A.McD.—9/60/3

Bonding of Water System

Q. *A feed processing plant is served by a 3-phase 3-wire, 480-volt service from an ungrounded system. A feeder is run from the service equipment to a transformer to obtain lighting service. The transformer is located on the opposite end of the building to the service equipment or a distance of approximately 100 ft. At the main service the switch box, conduit and equipment are grounded to an approved driven ground rod. The lighting transformer neutral is grounded to the water line near the transformer.*

Would Article 250 of the National Electrical Code require the interconnection or bonding of the water system and the driven ground rod?—M.R.L.

A. Yes. Section 250-81 requires that the water piping system always be used as the grounding electrode, if available. I would certainly say such system is available if in the building not over 100 ft distance. I also call to your attention Section 502-3 as most feed processing plants will have an area or areas of Class 2 Division 1 hazardous locations. Section 502-3 states in part:

"Surge Protection, Class II, Divisions 1 and 2. In geographical locations where lightning disturbances are prevalent, wiring systems

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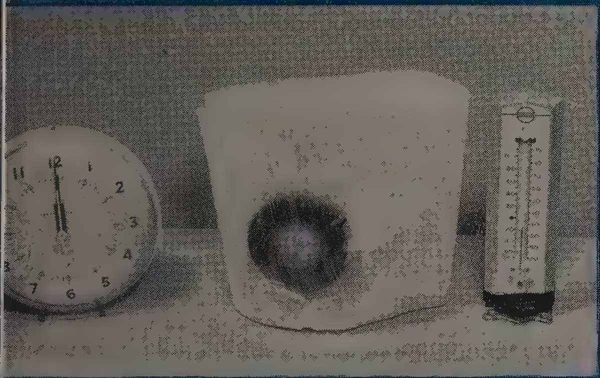

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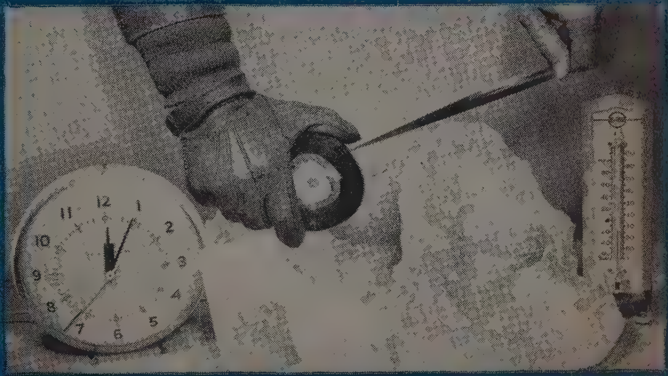

and in this frigid atmosphere remains completely flexible — strips perfectly from roll — even with ice still imbedded in the core.

4° F below zero, this remarkable vinyl tape
Strips easily from the roll . . .
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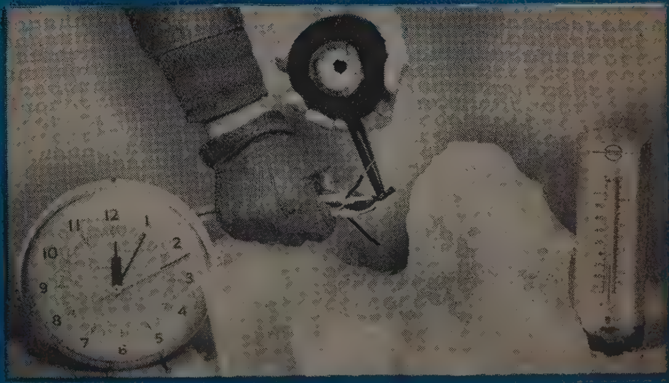

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in Class II locations shall, when supplied from overhead supply systems, be suitably protected against high-voltage surges. This protection shall include suitable lightning protective devices, interconnection of all grounds, and surge-protective capacitors."

A fine print note follows which in part reads as follows:

"Interconnection of all ground should include grounds for primary and secondary lightning protective devices, secondary system grounds if any, and grounds of conduit and equipment of the interior wiring system. For ungrounded secondary systems, secondary lightning protective devices may be provided both at the service and at the point where the secondary system receives its supply, and the intervening secondary conductors may be accepted as the metallic connection between the secondary protective devices, provided grounds for the primary and secondary devices are metallically interconnected at the supply end of the secondary system and the secondary devices are grounded to the raceway system at the load end of the secondary system."

I would have no objection to driven electrodes in addition to the water system as long as all grounding electrodes are properly bonded together. In many instances such recommendations are made and required.—R.E.W.—9/60/4

Well Casings as Grounding Electrodes

Q. I have a code problem that has bothered me for some time now, and it has been discussed in the meetings of the local electrical contractors, both among the contractors and with the inspectors who frequently attend our meetings, and it always reverts to "the inspector is right."

The inspectors require that all services in rural areas be grounded direct to the well casing. On all new construction this sometimes means, running the bare ground conductor underground 40 or 50 ft, using a 2-in. ground clamp, and then covering it up with about 5 ft of earth. While we understand that Article 250 in the code says that "an underground water system shall always be used when available," does not that same article say that the ground connection "shall be accessible?" Please give us an opinion on this matter.—G.R.

A. For the convenience of our readers, the provisions of Section 250-81 covering grounding electrodes is quoted as follows:

"A metallic underground water piping system, either local or supplying a community, shall always be used as the grounding electrode where such a piping system is available. Where the buried portion of the metallic piping system is less than 10 ft (including well casings bonded to the piping system) or there is some likelihood of the piping system being disconnected, it shall be supplemented by one or more of the grounding electrodes recognized in Sections 250-82 and 250-83."

The provisions of Section 250-82(c) recognize "other local metallic underground systems, such as piping, tanks, and the like" as grounding electrodes. The 1947 edition of the code, Section 2582(c), specifically recognized a metal well casing as a grounding electrode as follows: "A local underground piping system, metal well casing, and the like." It is significant to note that the recognition of a well casing, as a grounding electrode, is no longer specifically recognized in the code. It also appears important to note that the above quoted Section 250-81 appears to include bonded well casings as part of the metallic piping system.

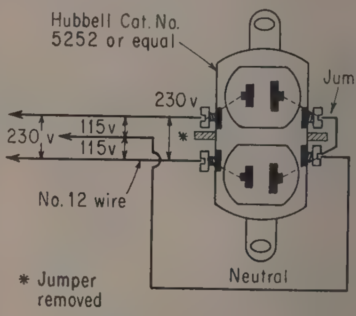
In view of the foregoing, it appears obvious that the 1959 edition of the code does not require the grounding conductor to be brought direct to the metal well casing. A literal concept of Section 250-81 indicates that the grounding conductor must be connected to the local metallic underground water piping system serving the building, with supplementary grounds if necessary. Such a connection usually is made in the building, and many inspectors require the waterpipe to be bonded to the well casing. To me, this is essential since the casing is in contact with damp or wet soil, and the buried portion of the piping may be in dry soil. The fine print note following Section 250-84 indicates that local metallic underground piping systems, metal well casings, and the like, have, in general, a resistance substantially below 25 ohms.

The provisions of Section 250-112 (a) requires the grounding connection to a water pipe electrode to be accessible, **where practicable.** It is also significant to note the following sentence which appears under this Section: "Where the source of the water supply is from a driven well (in the basement of the premises), the connection shall be made as near as practicable to the well." This is further evidence in support of the contention that the code, regardless of the location of the well casing, does not require a direct connection to the casing.—B.A.McD.—9/60/5

Break-Off Feature Receptacle

Q. Please give me a code ruling on the following:

Is it permissible to use a Hubbell No. 5252 or equal, duplex receptacle on a 115-230-volt, No. 12, 3-wire branch circuit, removing the jumper on the "hot" side, and using a common neutral, for use with two 1500-watt appliances. Is the spacing and barrier suitable for 230 volts across the two "hot" terminals?—L.E.M.



A. A Hubbell, Cat. No. 5252, receptacle is listed by Underwriters' Laboratories under its Reexamination Service, with a rating of 15 amps and 125 volts.

It has a break-off feature for two-circuit installations. When the jumper is removed, we actually have two separate receptacles and the combination may be served by a single-phase, 3-wire, 115/230-volt branch circuit as shown on your diagram. I believe that insulation provided by the barrier is sufficient for the 230-volt potential between the live terminals. In so far as this point is concerned, the design appears to be similar to Cat. No. 5292 which permits one of the receptacles to operate at 125 volts and the other at 250 volts.

In so far as the 15-amp rating is concerned, a 15-amp receptacle is limited to use on a 15- or 20-amp circuit. Two 1500-watt appliances connected to a 3-wire, 230-volt, 20-amp circuit takes 13 amps. Such a circuit loading appears to be in order provided the provisions of

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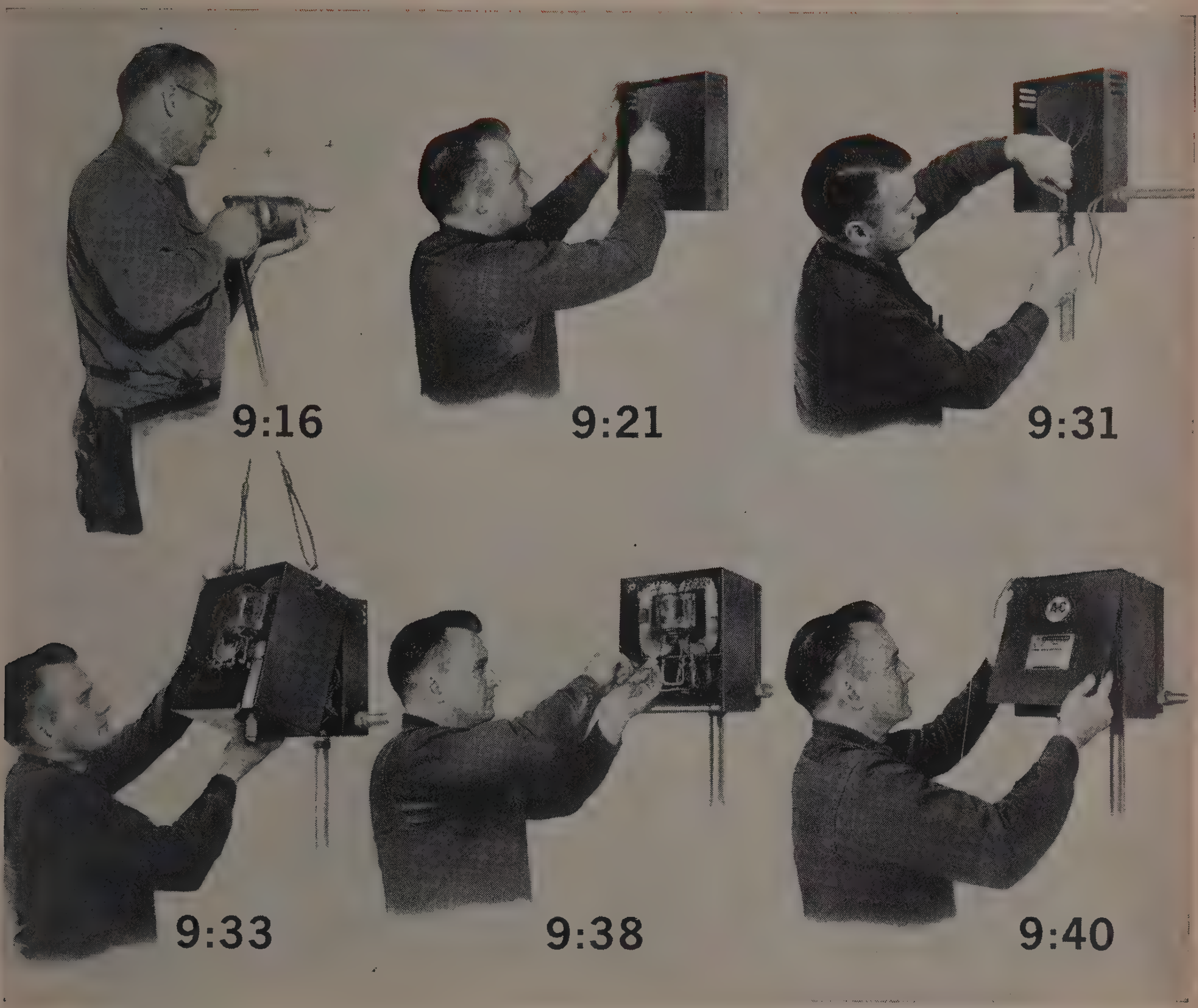

9:16 — 16 minutes to drill 4 holes in concrete wall and add lead inserts to receive screws. **9:21** — 5 minutes to mount back panel to wall. **9:31** — 10 minutes to punch out knockouts and attach conduit. **9:33** — 2 minutes to put center case section in place and tighten side screws. **9:38** — 5 minutes to pull cables and connect to terminals. **9:40** — 2 minutes to fasten front panel to center section with side screws. **Installing time: 40 minutes instead of the usual hour and a half!**

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Section 210-24 (a) which read as follows are satisfied:

"15- and 20-Amp Branch Circuits. Lighting units and/or appliances. The rating of any one portable appliance shall not exceed 80% of the branch-circuit rating. The total rating of fixed appliances shall not exceed 50% of the branch-circuit rating when lighting units or portable appliances are also supplied."

The question you have raised is interesting since the status of such types of receptacles does not appear to be clearly covered by UL listing. The 125-volt limitation could be interpreted to preclude the recognition of the 230-volt terminals. The 15-amp rating could be interpreted to limit the load served through the receptacle to 15 amps, instead of the 26 amps described above. Your question indicates that it would be very helpful if such questions were covered by UL when listing this type of a receptacle. At the present time there appears to be no distinction between a conventional receptacle, and one that has the break-off feature.—B.A.McD.—9/60/6

Service Disconnect Location

Q. *I have a question concerning locations of the service disconnecting means. Section 230-70(b) requires the disconnecting means to be located at a readily accessible point nearest to the entrance of the conductors either inside or outside the building wall. Other sections of the code clarify that the point of entrance of the service conductors is usually somewhere within the building or outside on the building wall. From this, I would infer that the disconnecting means could not be located on a pole outside of the building. Your letter of April 18, 1959, supports this view, as does an interpretation I have received from our local state inspector. However, Section 230-106(b) (1) states that the requirements for overcurrent protection and disconnecting means may be fulfilled by an approved switch used with suitable fuses on a pole outside the building. Does this mean that only the fuses may be located on the pole outside the building, or may the switch serving as the disconnecting means also be located on the pole outside the building? Also, if it is permissible for the service disconnecting means to be located on a pole outside the building, how far away from the building may the pole be located? I realize the code requires the disconnecting means to be readily accessible, but nowhere can I find a limitation on the distance one must travel to reach the switch in order that it may be classed as readily accessible. Please clarify these points if possible.—D.J.N.*

A. The provisions of Section 230-70(b) are general in nature since the code does not attempt to visualize and provide for the many variables which may be involved. As a result, the authority enforcing the code, as outlined under Section 90-7, has the responsibility for interpreting the rules in line with existing field conditions. A literal reading of the rule indicates to me that the service disconnect may be located at a readily accessible point nearest to the entrance of the conductors, either inside or outside the building wall. The phrase "entrance of the conductors" implies entrance at the building. As a result, the disconnecting means could be installed on the outside wall of the building or, as usual, on the inside wall of the building. This rule, which covers services 600 volts or less, does not recognize a service switch located on a pole as in the case of Section 230-106 (b) 1 and 2, which pertains to services exceeding 600 volts. The omission of any reference to "location on a pole" indicates to me that the intent of the rule when formulated did not anticipate such an installation.

Regardless of the foregoing opinion, it is common practice on farm installations to locate service and metering equipment on poles. The poles are located near the center of the load, and the service disconnecting means, so located, may be several hundred feet from some of the buildings served. Under such circumstances, Section 230-76 applies and supplementary switches are installed in the buildings served. Such an installation gives the farmer protection and control over his overhead conductors, which could be very important, if such conductors fall to the ground during ice and wind storms. Service disconnecting switches, so located, are considered by many inspection authorities to be "readily accessible." They contend that such switches may be reached more quickly than some of our indoor service installations.

The code definition of "readily accessible" does not cover the question in terms of distance. It reads as follows:

"Capable of being reached quickly, for operation, renewal, or inspections, without requiring those to whom ready access is requisite to climb over or remove obstacles or to resort to portable ladders, chairs, etc."

The nature of the wording indicates that questions of elevation and obstruction are prime considerations. The factor of distance is not covered since I believe it would be impractical to establish a rule in feet which would require "those to whom ready access is requisite" to be within a specified distance of the disconnecting means so that it may be reached quickly.

The provisions of Section 230-106(b) concern services exceeding 600 volts, and the provisions of paragraphs (1) and (2) specifically recognize service equipment, including fuse and switch, to be located on a pole outside the building. There is no reference to distance from the building. Here again the inspector must decide the question in line with existing circumstances. I do not believe there is any conflict with Section 230-70(b), since the provisions of Section 230-106(b) are a modification as covered by Section 230-100.

In other words, the code definitely recognizes the disconnecting means and overcurrent protection for a service exceeding 600 volts to be located on an outside pole. In some instances this may be a very desirable method of procedure regardless of the fact that it may be 25 or 50 ft away from the building.

In connection with my letter of April 18, 1959, we had a fused disconnect switch located on the pole, connected in the 120/208-volt secondary serving the building. The transformers also located on the pole were served by a 480-volt primary. As a result the provisions of Section 230-70(b) covering services, 600 volts or less, applied and my comment was based on this rule. If the code intends to recognize a service switch on a pole, as above described on farm installations, it appears that a code revision is in order.—B.A.McD.—9/60/7

Electric Range Installation

Q. *In the remodeling of a kitchen, the location of the electric range will be changed and in so changing, the range feeder,*

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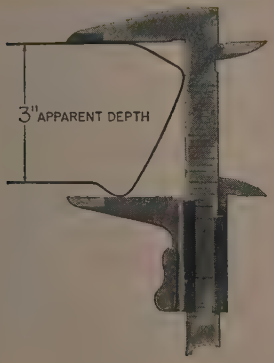

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which is 3-wire No. 8 service cable with uninsulated neutral, will not be of sufficient length to make connection to the range in its new location.

Can the cable be spliced and if so, how?—W.B.R.

A. Yes. The cable may be spliced by using a junction box of adequate size with a cover, and using approved connectors or bushings where the cable enters and leaves such junction box with the connections being spliced in an approved manner, either using pressure connectors or other approved means with joints insulated as is required by Section 110-14. Reference is also made to Table 370-6(a) and Section 370-7. Also, according to Section 370-19, JB's must be accessible.—R.E.W.—9/60/8

Wireway Application

Q. *We have a design project of upgrading a distribution system in two interconnected office buildings for the Air Force. This involves provision of transformers, feeders, panels, etc. It also includes reconnecting existing branch circuits from the old panels to the new.*

Owing to the nature of the building, maintaining flexibility, and economy it appears most feasible to use wireway for extending the branch circuits from the existing panels to the new, using the old panels to the new ones, using the old panels for junction boxes.

The question arises in the application of the wireway. According to Section 362-5 we are limited to 30 conductors and 20% of the cross-section area for fill. In some cases more than 30 conductors are required, and it just doesn't seem reasonable to run two wireways when a larger one could be selected. We are limiting the fill to 15% and derating the conductors in the wireway in all cases.

In discussing this question with the electrical engineer at the Air Defense Command Headquarters here, who is the technical reviewing authority for the Air Force before the plans go out for bids, we could not understand the philosophy on the limitation on the number of conductors. I wonder if you would clarify this point for us?—C.K.K.

A. As you say, the provisions of Section 362-5 limit the number of conductors in a wireway to 30, and the cross-sectional area of all contained conductors cannot exceed 20% of the interior cross-sectional area of the wireway. The correction factors in Note 8 of Tables 310-12 and 310-14 are not applicable to wireways.

This rule first appeared in the 1931 edition of the code, 29 years ago. At that time more than 30 conductors could be installed in a wireway by special permission. This permission was deleted in the 1937 edition of the code. Back in 1931, wireways were restricted to use in exposed dry locations in industrial occupancies. The principal occasion for such a wiring method was influenced by a desire to obtain a flexible wiring system so that circuits could be changed to meet changing conditions. An example is an industrial occupancy where machine tools are frequently moved or replaced for adaption to a specific job. Over the years the industrial occupancy restriction and other restrictions have been deleted, and according to the 1959 NEC are limited to exposed work where not subject to severe physical damage or corrosive vapor. They are not permitted in any hazardous location, but they are now recognized for outdoor installations when approved raintight construction is used.

The philosophy which influences the 30-conductor limitation is, to a considerable extent, expressed under Section 90-9 (b) which appears under the introduction to the code. It reads as follows:

"It is elsewhere provided in this code that the number of wires and circuits confined in a single enclosure be varyingly restricted. It is strongly recommended that electrical engineers and others who are planning installations provide similar restrictions wherever practicable, to the end that the effects of breakdowns from short circuits or grounds, even though resulting fire and similar damage are confined to wires, their insulation and enclosures, may not involve entire services to premises nor interruptions of essential and independent services."

While this philosophy still prevails, it is significant to note that the 1959 Code recognizes any number of conductors in a raceway (except wireways) when specified current derating factors are applied. See Table 1, Chapter 9. Previous to the 1959 Code, the number of conductors in a conduit or tubing was limited to nine, outside of a few exceptions. To determine if more than nine conductors could safely be installed in a raceway, and what derating factors should apply, the American Iron and Steel Institute sponsored a fact-finding investigation by the Underwriters' Laboratories, Inc. After more than two years of intensive investigation and study, the fact-finding report formed the basis for the new Table 1 with derating factors covered under Tables 310-12 through 310-15, Note 8. The report also recommended that a 40% fill be made to apply to all raceways including wireways; and that all restrictions with respect to the number of conductors in a raceway be eliminated, including wireways.

These recommendations were accepted for all raceways, with the exception of wireways and auxiliary gutters.

In view of the foregoing, the 1959 Code does not recognize more than 30 conductors in a wireway and the fill cannot exceed 20%. It is quite possible that a wireway could be used to considerable advantage on many applications on the basis of a 20% fill, and a 30 conductor limitation. Compared with conduit, the range of sizes is small, and on some installations a fill less than 20% would prevail. Such a factor of adequacy provides for future loads, and should be considered accordingly. It is possible that a future code will recognize the situation which prevails when a raceway is not filled to a 40% capacity. The question has already arisen with respect to conduit. Should the code recognize a 20% conduit fill with no derating factors when not more than 30 conductors are used? Is the condition any different than that which prevails with a wireway? Such questions have been recognized by the Technical Subcommittee supervising the UL Fact-Finding Report. The following statement appears in NFPA No. 70 PR-1958:

"The Technical Subcommittee calls attention to the fact that the derating factors recommended in this report are based on installations in excess of nine conductors and on raceway loading of 40% fill, whereas, especially in raceways where graded sizes of cross section are not available, it is quite common to find three and four wires in a raceway occupying much less than 40% fill. This presents a question as to whether special derating factors should be considered under these conditions. The Subcommittee recognizes that there would be many practical problems in the application of any such special factors."—B.A.McD.—9/60/9

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Grounding Type Receptacles

Q. *I was going through a new church building which is being constructed in our community, and I noticed that none of the receptacles are of the grounding type, including some weatherproof receptacles on the outside of the building.*

I am wondering if Article 2545 *of the* 1956 *Code and* 250-45 *of the* 1959 *Code would not require them to be used. I mention the* 1956 *Code because the building was contracted for and construction started in* 1958. *All of the floors are masonry construction.—C.R.A.*

A. The provisions of Section 2545 (250-45) cover the grounding of the exposed non-current-carrying metal parts of portable equipment. The 1959 edition of the code makes a distinction, between a residential and any other type of occupancy, with respect to the various types of appliances and tools which are required to be grounded. The provisions of Section 250-45 (c) in the 1959 Code are entirely new, and apply only to residential occupancies. This is the first time that the code has recognized the hazard presented by ungrounded portable appliances in a residential occupancy, operating at a voltage of 150 volts or less. This new rule is quoted as follows:

"In residential occupancies, (1) clothes-washing, clothes-drying, and dishwashing machines, and (2) portable hand-held, motor-operated tools and appliances of the following types: drills having a chuck capacity exceeding ⅛ in., hedge clippers, lawn mowers, wet scrubbers, sanders and saws."

While this new rule is not concerned with your code question, it is mentioned in view of its significance. A church occupancy is covered by Section 250-45 (d). This rule is the same as it appeared in the 1956 Code with minor editorial revisions. This rule is quoted as follows with editorial deletions as shown by the brackets:

"In other than residential occupancies, (1) [exposed metal parts of] portable appliances used in damp or wet locations, or by persons standing on the ground or on metal floors or working inside of metal tanks or boilers, and (2) portable tools which are likely to be used in wet and conductive locations [and not protected by insulated handles and enclosures] shall be grounded except where supplied through an insulating transformer with ungrounded secondary of not over 50 volts."

The method of grounding portable equipment by the use of a grounding type of receptacle and plug is covered by Section 250-59. When weatherproof receptacles are installed on the exterior outside wall of a church occupancy, it appears to me that they must be of the grounding type according to the 1959 or 1956 editions of the code. Receptacles, so located, may readily be used to serve portable appliances or tools, used by persons standing on the ground. Lawn mowers, drills, sanders, saws, hedge clippers are some of the appliances which may be served through receptacles located outside of the building. If grounding-type receptacles are installed, the contractor and the owner are in a favorable position in the event of an accident. When conventional receptacles are installed such concerned parties are assuming a responsibility which may be difficult to justify in the event someone suffers personal injury due to electric shock.

If the masonry floors are in direct contact with earth, they are considered to be wet locations, as covered by Section 310-5 of the code. Under such circumstances the above concept of code rules also applies. If such floors are covered by a conductive tile, such as some asphalt base tiles, this factor should be checked.

It is also significant to note the fine print note following Section 250-45 which reads as follows:

"It is recommended that the frames of all portable motors which operate at more than 50 volts and less than 150 volts to ground be grounded, where this can be readily accomplished." — B.A.McD. —9/60/10

Galvanized Water Pipe As Conduit

Q. *Does the code anywhere prohibit use of galvanized water pipe and fittings for raceways for electrical wiring?—G.F.*

A. It would be impracticable for the code to list all of the various materials which are not considered as suitable for wiring methods. Chapter 3 of the code recognizes the wiring methods and materials which are considered to be safe within the degree of safeguard established by the code. One of these wiring methods is rigid metal conduit. According to Webster a conduit is (1) a pipe or channel for conveying fluids, (2) a tube or protected trough for electric wires. According to Section 110-8 of the code: "Only wiring methods recognized as suitable are included in this code. The recognized method of wiring may be installed in any type of building or occupancy except as otherwise provided in this code." Section 110-2 advises that "the conductors and equipment required or permitted by this code shall be acceptable only when approved." Section 346-13 (b) has the following provision: "Steel conduit shall have an interior coating of a character and appearance so as to readily distinguish it from ordinary pipe commonly used for other than electrical purposes."

About 20 years ago, Official Interpretation No. 150 covered the question as follows:

"Question 2. May galvanized pipe be used as a means for mechanical protection for underground conductors that run up a pole?

"Finding: Pulling wires into iron pipe that is not conduit is not recognized in the code as a method for securing protection to contained conductors."

While the code does not specifically state that galvanized water pipe shall not be used as a raceway, it appears obvious from the foregoing that such use is not recognized. The same reasoning applies to nipples and fittings. In addition to the foregoing, there are several very good reasons why galvanized water pipe and fittings are not suitable as a raceway for conductors— B.A.McD.—9/60/11

Outdoor Sign Wiring

Q. *Can conductors with TW or RW insulation be used in outdoor sign wiring above ground when in flexible metal conduit such as would be used running from sign switch to sign outlets?—B.W.*

A. Yes. Section 350-2 of Article 350 states in part:

"Flexible metal conduit shall not be used in wet locations, unless conductors are of the lead-covered type or of other type specially approved for the conditions."

RW and TW are both approved for use in wet locations. Therefore, the answer is yes as far as the code is concerned although some inspectors object to the use of flexible metal conduit in outside locations.—R.E.W.—9/60/12

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Outlets in Wet Locations

Q. *We have had considerable differences of opinion over what is and is not a wet location. Would you please answer the following specific questions:*

a. Is the interior space of an exterior concrete masonry wall a wet location? What if the wall is painted on the outside with latex paint?

b. If an outlet box serving an outside light is embedded in an exterior concrete masonry wall, may the box be sheet metal or must it be cast? Does the same hold true if the wall is concrete?

c. Does the phrase "exposed to the weather" include such outside locations as under a small canopy or open porch? (See definition of "wet location.")

I have always required cast boxes on exterior work, whether surface or embedded. Please clarify whether this is the instent of the code in your opinion.—D.J.N.

A. A wet location is defined by the NEC as follows:

"A location subject to saturation with water or other liquids, such as locations exposed to weather, washrooms in garages, and like locations. Installations underground or in concrete slabs or masonry in direct contact with the earth shall be considered as wet locations."

In reply to question (a), it appears obvious that the interior space of an exterior concrete masonry wall is not a wet location, regardless of protection with latex paint. Such an area is not exposed to saturation with water, such as occurs in washrooms of garages, nor is it directly exposed to the weather. It is protected from the weather by its exterior surface. The phrase "exposed to the weather" is intriguing since the definition of weather covers the state of the atmosphere with respect to cold, heat, rainfall, drought, storms, fog, hail, snow, etc. There are some areas in the United States where rainfall is either nothing or very small, while other areas have a heavy monthly rainfall. The use of the word "weather" makes no distinction between the type of weather involved. I believe we all understand the intent, but it appears to me that the definition should cover the intent more clearly. I do believe, however, that the interior space of a concrete masonry wall below grade in direct contact with the earth would be considered a wet location. This observation is based on a literal reading of the rule, without any consideration of the extremely dry areas which prevail in some areas of our country. It would be very difficult, if not impractical, for the code to cover the various climatic conditions which exist in our country. It appears to me that the code, through the definition of "approved," gives the inspector considerable latitude to decide the correct procedure in line with existing circumstances.

Question (b). The provisions of Section 370-6 read as follows:

"In damp or wet locations, boxes and fittings shall be so placed or equipped as to prevent moisture or water from entering and accumulating within the box or fitting. Boxes and fittings installed in wet locations shall be weatherproof."

It is significant to note that this rule makes a distinction between an outlet box installed in a damp location and one installed in a wet location. An outlet box installed in a damp location is not specifically required to be weatherproof as is required for wet locations. "Weatherproof" is defined as follows: "So constructed or protected that exposure to the weather will not interfere with its successful operation." Raintight is defined as follows: "So constructed or protected that exposure to a beating rain will not result in the entrance of water."

In the case under discussion we have an outlet box, embedded in an exterior concrete wall covered by a lighting fixture. The box itself is not directly exposed to the weather or a beating rain, but the fixture is so exposed. As a result, the fixture is required to be raintight, and the box is only required to satisfy the provisions of Section 370-6 quoted above. Reference to UL 57, electric lighting fixtures, indicates that a fixture intended for outdoor use or for use in other wet locations will be marked to indicate such use. A summary of the foregoing rules indicates to me that a sheet-metal box could be used insofar as code rules are involved. A typical example is the small floodlight fixtures approved by UL which are used for outside lighting on residential and farm properties. Such fixtures are designed to be attached to conventional outlet boxes recessed in the wall of the building.

Question (c). I do not believe that a recessed box under a small canopy, or an open porch, is considered to be in a wet location.—B.A.McD.—9/60/13

Grounded Conductor

Q. *Can service-entrance cable with a covered neutral (uninsulated) be used in interior wiring as a feeder from the service entrance equipment to a 115-volt distribution panel in a residence with the two insulated conductors being used as current-carrying conductors and the covered or uninsulated wire being used as a grounding conductor only?—R.M.M.*

A. Yes. The answer to your question will be found in the fine-print note in Article 338:

Sec. 338-3. Use as Branch Circuit or Feeders.

"(a) Service-entrance cables may be used in interior wiring systems where all the circuit conductors of the cable are of the rubber-covered or thermoplastic type.

"(b) Service-entrance cables without individual insulation on the grounded conductor may be used only for range, wall-mounted oven and counter-mounted cooking unit, and clothes dryer circuits, or as feeders from a service cabinet to supply other buildings, or as service-entrance conductors for such other buildings, when the following conditions are met:

(1) The cable has a final nonmetallic outer covering.
(2) The supply is alternating current not exceeding 150 volts to ground."

Fine Print Note:

"The above provisions do not intend to deny the use of service entrance cable for interior use when the fully insulated conductors are used for circuit wiring and the uninsulated conductor is used for equipment grounding purposes."

The above note has been inserted as a result of Official Interpretation No. 419 which read:

"Under the intent of Section 3382 may approved 3-conductor service-entrance cable, having two insulated conductors and one conductor without individual insulation, be used for 2-wire branch circuits when the uninsulated conductor is intended solely for grounding purposes? Answer: Yes."

In all probability your neutral or grounded conductor will require identification and in a case of this kind inspectors usually will allow the identification to be done by using paint on the neutral as is outlined under Section 200-6. Means of Identification of Grounded Conductors.—R.E.W.—9/60/14

Conductors in Multiple

Q. *Section 310-10 of the NEC states that conductors of 1/0 and larger may be run in multiple, etc.*

Please give me the reason or reasons why conductors smaller than 1/0 cannot be run in multiple.

I have had many inquiries on that section and would appreciate an explanation.—P.B.

A. For the convenience of our readers the provisions of Section 310-10 are quoted as follows:

"Conductors in sizes 1/0 and larger may be run in multiple provided they are of the same length and have the same circular-mil area and type of insulation. When conductors are run in multiple, they shall be arranged at both ends in such a manner as to assure equal division of the total current between all conductors that are involved."

Back in 1930 the rule read as follows: "Conductors may be placed in multiple only by permission of the authority enforcing the Code." During the past 30 years the rule has been revised on several occasions.

Speaking in general, conductors run in multiple present a hazard when the above qualifications are not satisfied. When the parallel conductors are not of the same length, and the resistances of terminal connections are unequal, we may expect to find unequal resistances over the parallel path. Since the current over each conductor is inversely proportional to its resistance, the conductor having the lower resistance will "hog the load," become overloaded, and its maximum operating temperature may be exceeded. In addition to the hazard involved, such a condition could promote excessive voltage drop.

If the code did not recognize conductors 1/0 or larger to be run in multiple, it would be impracticable to install larger services and feeders, 700 amps and upward, with insulated conductors. Outside of the provisions of Section 620-12(a) covering traveling cables for lighting circuits on elevators, I do not believe that the code recognizes the use of conductors smaller than 1/0 to be run in multiple. The code does not generally recognize such use since there appears to be no occasion to do so, and it might be more difficult to obtain equal resistances over the parallel paths.—B.A.McD.—9/60/15

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THE PYLE-NATIONAL COMPANY, 1344 N. Kostner Avenue, Chicago 51, Illinois ■ *District offices and representatives in principal cities of the United States.* ■ *Manufactured in Canada by Pyle-National (Canada) Ltd., Toronto 15.*

CONNECTORS ■ LIGHTING FIXTURES ■ CIRCUIT CONTROLS

★ "MARKETS UNLIMITED" ★

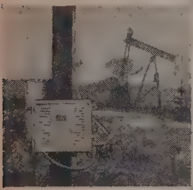
3-PHASE POWER
from
SINGLE PHASE
with
Add-A-Phase®
POWER CONVERTER

HOME
AIR CONDITIONING
AND WORKSHOPS
No three phase wiring necessary. The Add-A-Phase opens the air conditioning market to you.

INDUSTRY
Location may make three phase wiring prohibitive. The Add-A-Phase permits use of 3-Phase equipment without 3-Phase wiring.

FARMS . . .
IRRIGATION
Inaccessable locations dictate an Add-A-Phase. Modern "automated" farm may require multiple Add-A-Phase installations.

WATER WORKS
. . . SEWAGE
Rural expansion assures a growing market for the Add-A-Phase. No loss of workpower with the Add-A-Phase.



OIL FIELDS
Years of constant oil field pumping proves durability of Add-A-Phase without maintenance calls.

Add-A-Phase®
POWER CONVERTER
100% rated load
Unity Power Factor
Balanced Currents
No loss of Work Power

Write for Complete Information

ADD-A-PHASE Dept. ECM-9
Div. System Analyzer Corp., Nokomis, Illinois

Gentlemen: Please send, without obligation, complete details on your ADD-A-PHASE Power Converter.

Name________________Title________
Company____________________________
Address____________________________
City________________Zone_________
State______________________________

SEE FOR YOURSELF . . . package includes many case histories of the success of the Add-A-Phase . . . years of trouble free use. IF YOU HAVE A SPECIFIC ELECTRIC POWER PROBLEM GIVE US THE DETAILS FOR RECOMMENDATION.

ESTIMATING FORUM—IV

[FROM PAGE 107]

job was entitled to a lower overhead than the hospital project.

Jones' revised estimate for the industrial project is shown in Fig. 5. Note that he now used overhead markups of 7% on material and 25% on labor instead of the 8% and 30% figures applied to his original estimates for both the hospital and industrial bids. His revised estimated "sell price" for the industrial job was within $54 of the low bidder's estimated sell price. To meet the low bid, Jones' actual sell price was less than 1% under his revised estimate.

FIG. 2—LOW BIDDER'S HOSPITAL ESTIMATE

Material—purchase price		$10,500
Labor—payroll		10,800
Total base cost		$21,300
Direct job expense	3%	639
Total direct job cost		$21,939
Overhead	15%	3,291
Complete installation cost		$25,230
Profit	10%	2,523
Estimated sell price		$27,753

Bid Price $27,750

FIG. 3—JONES' ORIGINAL INDUSTRIAL PROJECT ESTIMATE

		MATERIAL		LABOR
Base costs (material purchase)		$12,600	Payroll	$8,000
Direct job expense (material)	2%	252		
Direct job expense (labor)	6%	480		
		$13,332		$8,000
Overhead	8%	1,067	30%	2,400
Complete job costs		$14,399		$10,400
Return	5%	720	10%	1,040
Sell price—Material		$15,119		$11,440
Sell price—Labor		11,440		
Estimated sell price—The Job		$26,559		

Bid Price $26,600

FIG. 4—LOW BIDDER'S INDUSTRIAL PROJECT ESTIMATE

Material—purchase price		$12,600
Labor—payroll		8,000
Total base cost		$20,600
Direct job expenses	4%	824
Total direct job cost		$21,424
Overhead	10%	2,142
Complete installation cost		$23,566
Profit	10%	2,357
Estimated sell price		$25,923

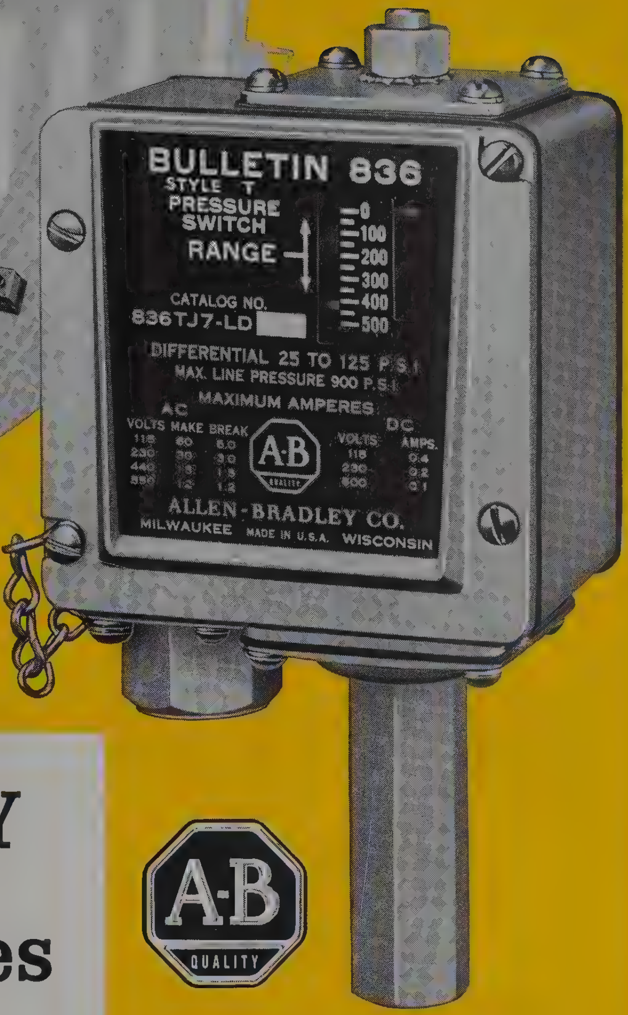
Bid Price $25,750

FIG. 5—JONES' REVISED INDUSTRIAL PROJECT ESTIMATE

		MATERIAL		LABOR
Base costs (material purchase)		$12,600	Payroll	$8,000
Direct job expense (material)	2%	252		
Direct job expense (labor)	6%	480		
		$13,332		$8,000
Overhead	7%	932	25%	2,000
Complete job costs		$14,264		$10,000
Return	5%	713	10%	1,000
Sell price—Material		$14,977		$11,000
Sell price—Labor		11,000		
Estimated sell price—The Job		$25,977		

Actual Price to Meet Low Bid—$25,750

en-station transfer machine in
se at major auto plant. This
ew shows 9 of the 45 A-B
ulletin 836 pressure switches
nd 2 special Allen-Bradley con-
ol stations on the machine.



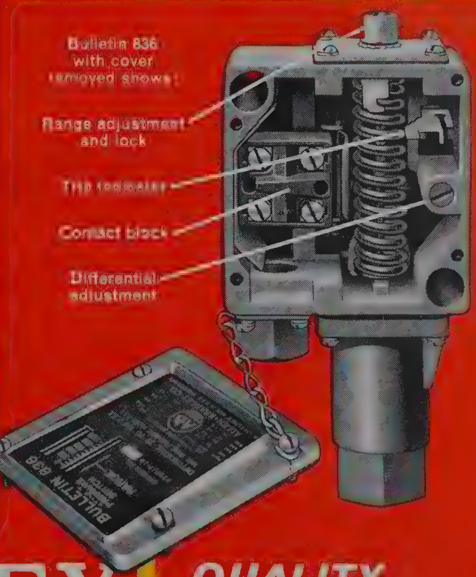
Bulletin 836 Style T
Oiltight Pressure Switch

ALLEN-BRADLEY
OILTIGHT
Pressure Switches

provide consistent accuracy and maximum reliability

These rugged Allen-Bradley Bulletin 836 Style T oiltight pressure switches are specifically designed to take the punishment of hard, day-in and day-out industrial use. The die-cast aluminum housing is completely sealed. Oil cannot get in and foul the contacts—even when it flows over the enclosure in a continuous stream. The precision switch mechanism insures extreme accuracy of repeatability. An extremely important feature lies in the "snap action" of this switch—it maintains its normal contact pressure up to the instant of switchover—regardless of how slowly the trip point is approached. Contact chatter—which means unreliable operation—is impossible, and contact life is greatly increased. The contact block has two isolated circuits with one N.O. and one N.C. set of contacts.

Both the operating pressure and the differential are adjustable. The pressure is externally adjustable with the setting shown on a calibrated scale, and a trip indicator shows the operating point. These A-B *quality* controls are made for operating at pressures up to 5000 psi. Write for full details.


Bulletin 836 with cover removed shows:
Range adjustment and lock
Trip indicator
Contact block
Differential adjustment
BULLETIN 836

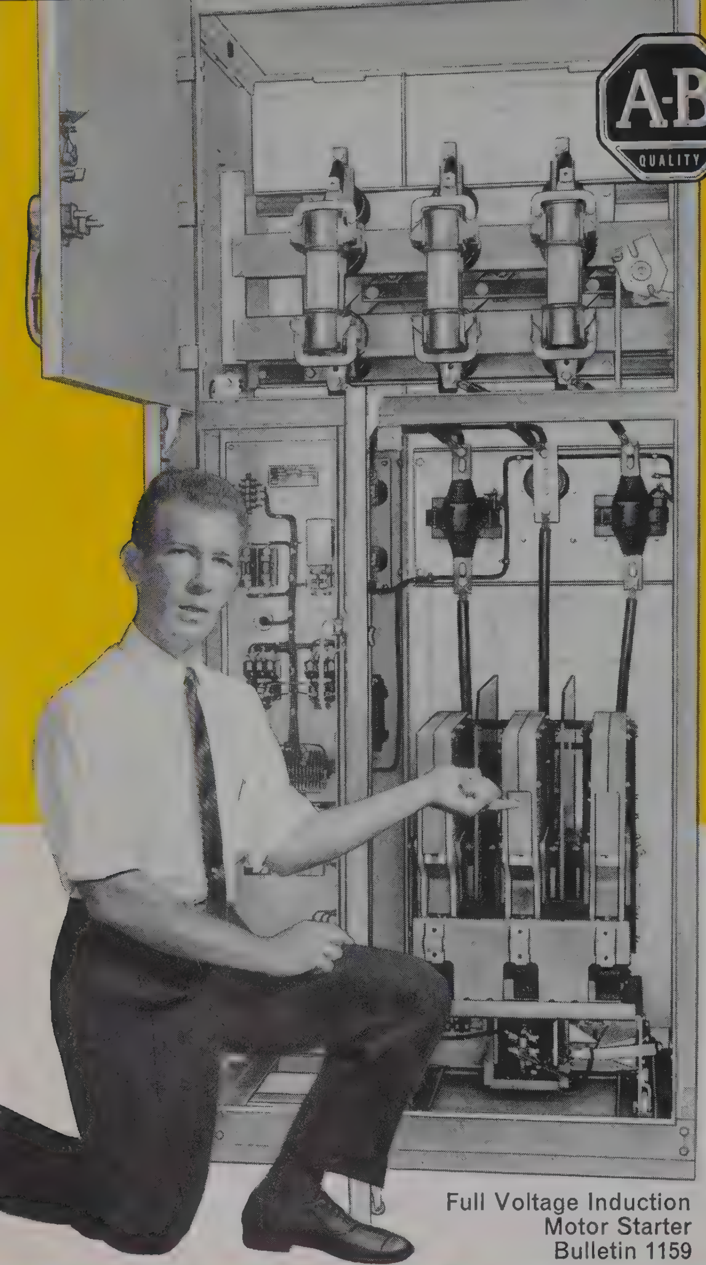
ALLEN-BRADLEY

Member of NEMA

QUALITY MOTOR CONTROL

Allen-Bradley Co., 1316 S. Second St., Milwaukee 4, Wis. • In Canada: Allen-Bradley Canada Ltd., Galt, Ontario

12-60-MR



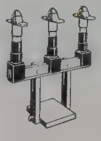
The only HIGH VOLTAGE STARTERS

built to provide millions of trouble free operations

An astounding claim but true! The secret of this remarkable operating life of Allen-Bradley high voltage air break starters is found in the extremely short contact travel—*it's only ⅜″*. Thus, pounding and contact wear are reduced to a minimum. In addition, contactors in A-B high voltage starters have only ONE moving part. It's the same simple solenoid design that has proved good for millions of trouble free operations in A-B low voltage starters. And like A-B low voltage starters, the double break, silver alloy contacts never need maintenance. For complete details on Allen-Bradley high voltage starters, send for Publication 6080.

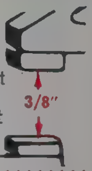
Full Voltage Induction Motor Starter
Bulletin 1159

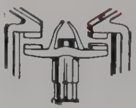
FEATURES OF THE ALLEN-BRADLEY RUGGED SOLENOID AIR BREAK CONTACTOR



ONE MOVING PART
All trouble-causing pivots, pins, and flexible jumpers are eliminated.

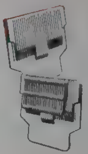
CONTACT TRAVEL ONLY 3/8″
Reduced impact and pounding extends contact operating life.





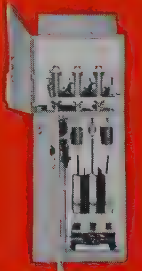
DOUBLE BREAK CONTACTS
of silver alloy completely eliminate the need for contact maintenance.

FAST ARC SUPPRESSION
New blowout design, new arc chutes molded of arc resistant material.

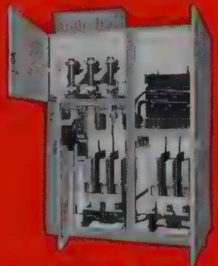


ALLEN-BRADLEY HIGH VOLTAGE STARTERS ARE MADE FOR ALL TYPES OF MOTORS AND ALL TYPES OF SERVICE

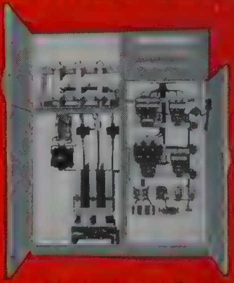
Reduced Voltage
Induction Motor Starter
Bulletin 1172



Full Voltage
Synchronous Motor Starter
Bulletin 966



Reduced Voltage
Synchronous Motor Starter
Bulletin 983



Wound Rotor Motor Starter
Bulletin 1160

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QUALITY MOTOR CONTROL

17-60-MR

How You Can Help to Improve The NEC

Do you have a pet code subject? Maybe you feel an existing code rule is too weak or too strict. Or perhaps the code doesn't cover your idea at all. Here's how you —as an individual—can do something about it.

TOO many members of the electrical industry don't realize that individuals can submit their proposals for changes to the NEC. And these proposals will be given the same consideration as those submitted by the many organized electrical groups who have so capably contributed to the betterment of the code.

However, according to the latest code timetable, proposals by individuals must be submitted on or before December 1, 1960 to be considered for adoption in the 1962 edition of the NEC. Therefore, the time to act is now.

Included in this article is an up-to-date list of the names and addresses of the code panel chairmen, and the president and secretary of the Electrical Section of the NFPA. In addition, a flow chart indicates how a proposal is handled through the various panels and committees to eventual adoption in the next code edition; that is, if a proposal is worthy.

Before writing down your code proposal, check it against the type that usually catches the eye of the NE Code-makers.

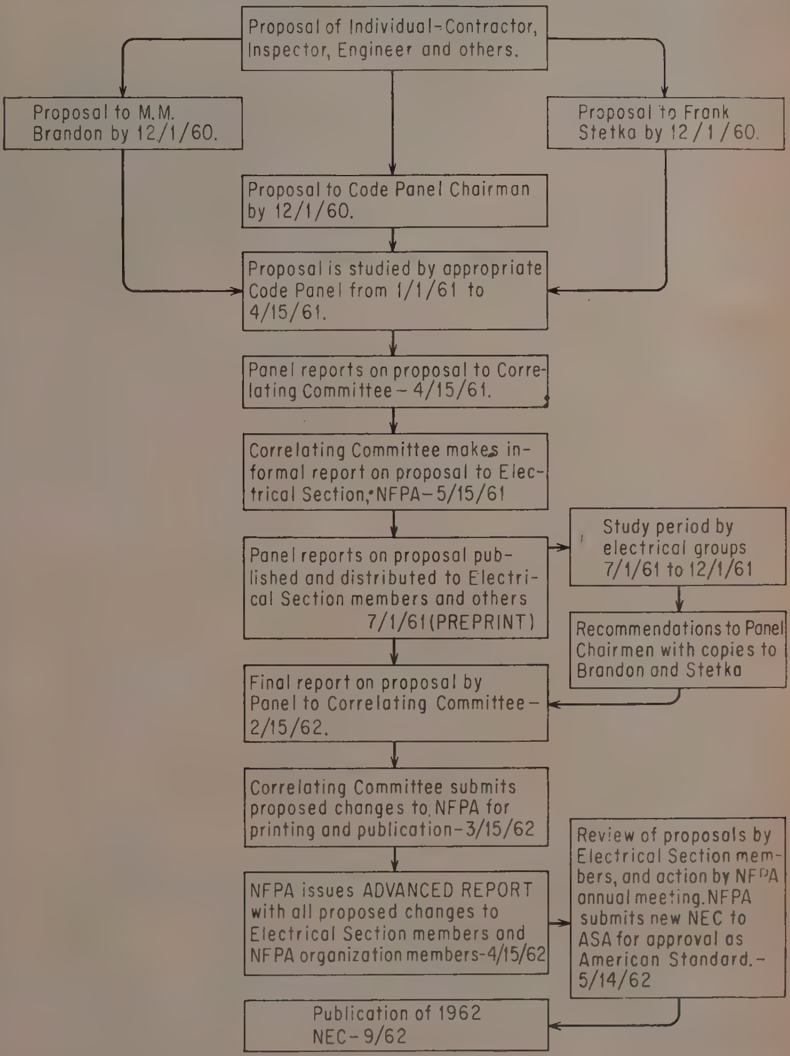
1. One should bear in mind that the NEC is a minimum safety standard, and all proposals should be predicated on this assumption.

2. Each proposal should include the reason why a code change is necessary. This would include supporting evidence or documentary evidence to justify a change. Or it might be a case history of an electrical equipment failure which has caused an injury or fire, and there is no present code rule covering the situation. All members of the NE Code-making panels serve voluntarily and without remuneration. We can help them immensely if, as individuals or associations, we follow these two major considerations in submitting proposals for code changes.

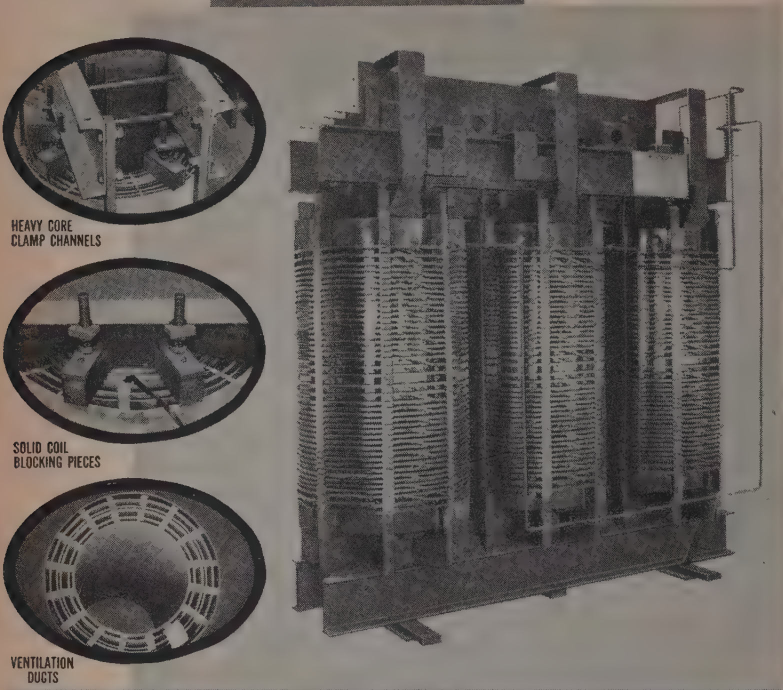
Now, if you have a code revision that measures up to these two points, the first step is to write it up and send it to:

Merwin M. Brandon, Chairman,
NEC Correlating Committee
Underwriters' Laboratories, Inc.
207 East Ohio St., Chicago 11,
Ill.

A copy of this letter should be sent to:


Proposal of Individual-Contractor, Inspector, Engineer and others.
Proposal to M.M. Brandon by 12/1/60.
Proposal to Frank Stetka by 12/1/60.
Proposal to Code Panel Chairman by 12/1/60.
Proposal is studied by appropriate Code Panel from 1/1/61 to 4/15/61.
Panel reports on proposal to Correlating Committee - 4/15/61.
Correlating Committee makes informal report on proposal to Electrical Section, NFPA-5/15/61
Panel reports on proposal published and distributed to Electrical Section members and others 7/1/61 (PREPRINT)
Study period by electrical groups 7/1/61 to 12/1/61
Recommendations to Panel Chairmen with copies to Brandon and Stetka
Final report on proposal by Panel to Correlating Committee - 2/15/62.
Correlating Committee submits proposed changes to NFPA for printing and publication-3/15/62
NFPA issues ADVANCED REPORT with all proposed changes to Electrical Section members and NFPA organization members-4/15/62
Review of proposals by Electrical Section members, and action by NFPA annual meeting. NFPA submits new NEC to ASA for approval as American Standard.-5/14/62
Publication of 1962 NEC-9/62

TYPICAL OF **HEVI-DUTY** TRANSFORMERS



Designed for durability and compactness... maximum cooling with ventilated construction

What makes a good dry type transformer? Sturdy clamping construction assures ample damping of core vibration, and complete air-flow ventilation between core and coils provides years of trouble-free service under continuous operation. Hevi-Duty Dry Type Transformers—single and three-phase up to 3000 KVA—give you all this plus extremely low decibel ratings.

HEAVY CORE CLAMPING CHANNELS

Core is tightly clamped between steel weldments which help to maintain quiet operation.

SOLID COIL BLOCKING

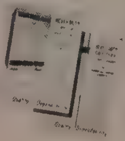
Coils are rigidly blocked with individual pressure blocks to withstand internal stresses, and provide protection against load short circuits and lightning or switching surges.

STEP-CORE CONSTRUCTION WITH VENTILATING DUCTS

The air flow through cooling ducts between core and coil base assures minimum temperature rise in the center leg as well as on outside legs.

● Step-core construction and individual pressure blocking pieces are standard features on all Hevi-Duty transformers. You can be sure of obtaining these features by specifying "STEPPED CORE CONSTRUCTION REQUIRED, WITH INDIVIDUAL COIL PRESSURE BLOCKING PIECES."

For more information on Hevi-Duty Dry Type Transformer design features, write for Bulletins 100 and 200.



HEVI-DUTY

A DIVISION OF BPC BASIC PRODUCTS CORPORATION

HEVI-DUTY ELECTRIC COMPANY, MILWAUKEE 1, WISCONSIN
Industrial Furnaces and Ovens, Electric and Fuel • Laboratory Furnaces • Dry Type Transformers • Constant Current Regulators

JACK L. BLACKLEDGE has been named executive director of the Electrical League of New York Inc., succeeding Don E. Rosenthal, who has moved to California. Over a period of 36 years Blackledge has been employed in a number of industry positions including manufacturing, distribution and electrical construction. For the past year he has been managing a group of electrical supply houses in upstate New York.

Frank Stetka, Secretary,
NEC Correlating Committee
612 North Michigan Ave.
Chicago, Ill.

And while not required, it is a good idea to send a copy of the proposal to the chairman of the appropriate code-making panel. The panel chairmen, their addresses, and the code articles that come under their jurisdiction are as follows:

NE Code-Making Panel Chairmen

Panel on Introduction—Article 90. D. L. Johnson, 309 City Hall, Atlanta 3, Ga.

Panel No. 1—Articles 100-110. Kent Stiner, BullDog Electrical Products, Box 177, Detroit 22, Mich.

Panel No. 2—Articles 200, 210, 215, 220, 700. H. H. Watson, General Electric Co., 1285 Boston Ave., Bridgeport 2, Conn.

Panel No. 3—Articles 230, 600, 730. O. K. Coleman, Edison Electric Institute, P. O. Box 705, Lafayette, Ind.

Panel No. 4—Articles 240. R. L. Lloyd, National Bureau of Standards, Rm. 4042, Industrial Bldg., Washington 25, D. C.

Panel No. 5—Articles 250, 280. L. S. Inskip, Bell Telephone Lab-

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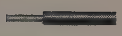
1 STRIP WIRE 

2 INSERT WIRE

Suddenly outmoded are tools, tape, twisting, and tucking of excess wire.

Wires cannot pull out of — nor work loose from — the handsome red thermoplastic Wiremold Wire Connector, which measures 1-5/16" x 1/2" x 5/16" and even has a strip gage molded into it.

No slack is needed for any T-splice, so Plugmold now becomes even easier to install and can save more time on every job.

Connects as many as four No. 14 or No. 12 conductors. UL listed, of course.

Included with every Plugmold wired section and every package of Snapicoil.

Wiremold Wire Connectors can be bought in cartons of 10 or 50. At Wiremold distributors. Now.

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HERE'S WHERE THE MONEY GOES WHEN YOU BUY LIGHT

For the average industrial user, approximately 10 cents of every dollar spent for light goes for lamps; approximately 20 cents goes for maintenance labor; and about 70 cents goes for electric power.

2 100's WON'T DO THE WORK OF 1 200

A 200 watt incandescent lamp produces approximately 3800 lumens. Two 100 watt incandescent lamps produce approximately 3400 lumens — about 10% less light.

WATT FOR WATT, FLUORESCENTS PRODUCE TWICE AS MUCH LIGHT AS INCANDESCENTS

About 7.5% of the electrical energy consumed by a typical 40 watt incandescent lamp is produced as light. In a typical 40 watt fluorescent lamp, the percentage is about 20.5. In both types, the remainder of the electrical energy is heat loss.

OVER 200 INSPECTIONS GUARD CHAMPION LAMP QUALITY

Checks and counter checks at each step of production guard the quality and uniformity of Champion lamps. Result: you get all the light you pay for when you use Champions.

CHAMPION LAMP WORKS, Lynn, Massachusetts

CHAMPION INCANDESCENT-FLUORESCENT • *YOUR BEST BUY IN LAMPS*

ATTENDING the meetings of the New York State Electrical Contractors and Dealers, Inc. at Whiteface Inn were Samuel Gold, Jandous Electric Construction Corp., New York; John Doris, John Doris, Inc., New York City; and C. A. Mulligan, Charles A. Mulligan, Inc., Central Islip, N. Y.

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oratories, Inc., Murray Hill, N. J.

Panel No. 6—Articles 300, 310, 400. H. R. Stevenson, Detroit Edison Co., 2000 Second Blvd., Detroit 26, Mich.

Panel No. 7—Articles 320, 324, 328, 330, 334, 336, 338, 339, 342, 344, 390. Joseph Whitner, South-Eastern Underwriters Association, Box 5048, Atlanta, Ga.

Panel No. 8—Articles 346, 348, 350, 351, 352, 353, 354, 356, 358, 362, 364. W. R. Volheye, Bureau of Labor, 1216 S. W. Hall St., Portland 1, Oregon.

Panel No. 9—Articles 370, 373, 374, 380, 384. W. P. Hogan, Jr., Chief Electrical Inspector, City of Chicago, 321 N. La Salle St., 4th floor, Chicago 10, Ill.

Panel No. 10—Articles 402, 410, 422. Buford Martin, Electrical Development Branch of Tennessee Valley Authority, 417 Edney Bldg., Chattanooga, Tenn.

Panel No. 11—Articles 430, 445. Richard W. Osborn, Osborn Electric Company, 5516 S. Kingshighway, St. Louis 9, Mo.

Panel No. 12—Articles 610, 620, 630, 670. E. E. Carlton, California Div. of Industrial Safety, 965 Mission St., San Francisco 3, Calif.

Panel No. 13—Articles 450, 460, 470, 710. C. F. Hedlund, Factory Mutual Engineering Div., P. O. Box 510, Norwood, Mass.

Panel No. 14—Articles 480, 500-503, 510-517. F. J. Zeleny, Western Regional Office, Factory Insurance Association, 175 W. Jackson Blvd., Chicago 4, Illinois.

Panel No. 15—Articles 520, 530,

Now . . . from the company that created the tapes used in the satellites . . .
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PLASTIC ELECTRICAL TAPE
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PRODUCTS, INC., CHICAGO 39 • PLASTIC

MYSTIK BRAND

a plastic electrical tape of SUPERIOR QUALITY!

MYSTIK BRAND Plastic Electrical Tape is made by the same company that introduced silicone adhesives—the company that created the hi-low temperature tapes used in the U. S. satellite and missile program. Here's a tape you *know* you can count on!

MYSTIK No. 6407 offers some important advantages you *ought to hear about.* It's easy to use—sticks quickly and conforms readily to irregular surfaces. Saves you taping time. No. 6407 offers high dielectric strength and laughs off oil, acids, alkalies, weather and wear. Seals tight as a drum—assures trouble-free performance on every job.

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ROYAL
"POWR-KORD"

. . . the all-quality line of all-purpose heavy-duty extensions

Here's the kind of rugged construction that pays off on the job: MOLDED-ON caps and connectors, — built-in strain reliefs — Royal-quality cord — heavy brass blades and double-wipe contacts — locked-in-place molded construction . . . and FULLY UL LISTED!

Next time you're ordering electrical supplies from your wholesaler, be sure to include Royal "POWR-KORDS".

There's a Royal "POWR-KORD" for every need:

- RUBBER or VINYL
- BLACK or RED (rubber)
- RED or YELLOW (vinyl)
- HANDY LENGTHS — from 10' to 100'
- IN THESE TYPES and SIZES:
  #18 and #16 SJ — 2- and 3-conductor
  #18 thru #12 S — 2-conductor
  #14 and #12 S — 3-conductor
  #18 and #16 SJT — 2-conductor

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. . . an associate of IT&T

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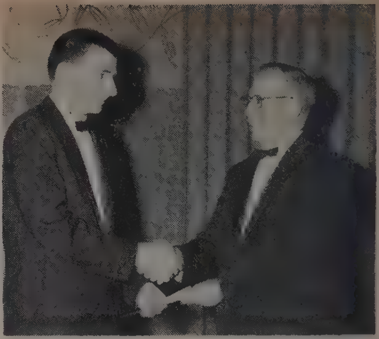


WINNER of first prize in the commercial classification of the IES Applied Lighting Competition, New York Section, was Noel Florence (left), luminaire designer for Lightolier, Inc., New York City, receiving check and congratulations from Ray L. Smart, IES Vice President, Northeastern Region, and illuminating engineer, Boston Edison Co., Boston. The award was based on the lighting of the new Time and Life Building, at Sixth Avenue and 50th Street, New York City.

540, 640, 650, 810. K. S. Geiges, Underwriters' Laboratories, Inc., 1655 Scott Lane, Santa Clara, Calif.

Panel No. 16—Articles 720, 725, 800. F. T. Wright, Underwriters' Laboratories, Inc., 161 Sixth Ave., New York 13, N. Y.

Panel No. 17—Articles 660, 665. M. G. Folkes, Chief Electrical Inspector, 306 City Hall Annex, Richmond 19, Va.

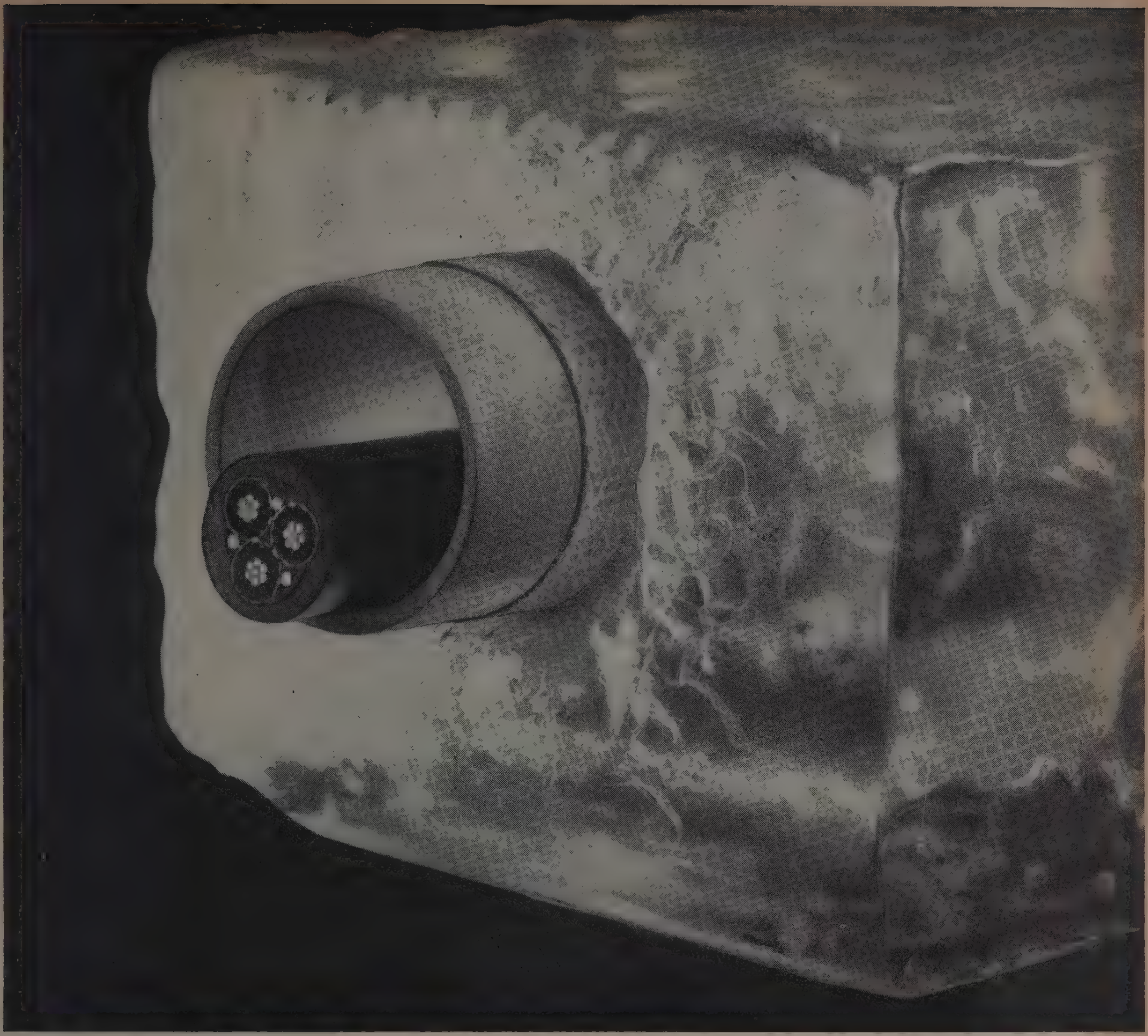
Any contribution you can make regarding improved code changes will result in a better-accepted, higher-regarded, up-to-date NEC. Increased interest shown in any standard can only bring about improvement and better understanding.

NYBFU Extends Effective Date of N-I Breakers

Carlton E. Schaad, State Superintendent of the New York Board of Fire Underwriters, Bureau of Electricity, has announced that the mandatory compliance of Section 240-25 (g), 1959 NEC, will be extended to January 1, 1961 in the State of New York.

While the effective date of compliance for non-interchangeable circuit breakers is stated as July 1, 1960 in the 1959 NEC, several problems relating to revised UL standards and manufacturing schedules have justified the extension.

The NYBFU thought that the date of January 1, 1961 would be

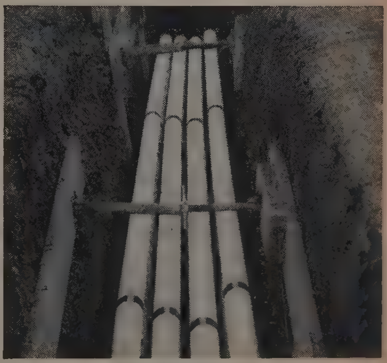


Cooler cables at lowest costs with Transite Ducts!

Do you know that electrical system losses amount to more than four hundred million dollars annually? Research shows that these losses can be drastically reduced by improving the dissipation of heat from conductors under load. The most efficient and economical way to accomplish this is with inorganic Transite® Ducts.

Tests prove that asbestos-cement Transite Ducts can actually have as much as 110.6% greater heat-carrying ability than organic ducts. This means that when a conductor is supplying a given load, its temperature will be substantially lower in Transite. These cooler cables result in lower electrical resistance with correspondingly lower I^2R losses. At a $20/KW cost, this can save you as much as $8.20 per thousand feet a year. Lower operating temperatures mean longer cable life and more reliable service, too!

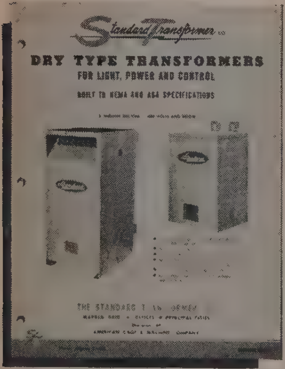
Because of their 10′ lengths and speedy coupling method, Transite Ducts can be installed at the lowest cost. Get the full story by writing Johns-Manville, Box 14, ECM-9, New York 16, N. Y. In Canada: Port Credit, Ontario.



JOHNS-MANVILLE

JOHNS MANVILLE JM PRODUCTS

NEW BULLETIN FREE . . .
Gives weights, sizes and performance features of Standard's dry type line.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DRY TYPE TRANSFORMERS
FOR LIGHT, POWER AND CONTROL
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Standard dry type transformers for light, power and control are designed for service wherever equipment is required in hazardous areas. Most major oil companies use them. Standard's compound fills the entire case, hardens and seals out lint, dust and dirt. They cut noise levels, improve regulation, reduce temperature rise and are lighter in weight and smaller in size.

Get the facts today from your nearby Standard representative or write directly to us.

Standard Transformer co.

EXPRESS 2-1563 • WARREN, OHIO
"WHEREVER THERE IS POWER"

FATHER AND SON, Herbert F. Janick and J. David Janick of T. H. Green Electric Co., Inc , Rochester, N. Y., attended the convention of the New York State Electrical Contractors and Dealers, Inc. at Whiteface Inn.

logical as the effective date to start using **N-I circuit breakers, because** this is the same date that the NEC will require the installation of Type S plug fuses and fuseholders. And since both CBs and fuses perform the same function as overcurrent devices, it is reasonable to assume that it would be more equitable to start the enforcement of both at the same time.

Non-interchangeable circuit breakers and Type S fuses have one basic difference in code application. Type S fuses and fuseholders will be required in any type of occupancy in range classifications of 0-15 amps and 16-30 amps. On the other hand, N-I circuit breakers will be required only in residential occupancies, or other occupancies where proper maintenance and supervision do not exist, and they will be required only for lighting and appliance branch circuits in range classifications of 0-20 amps, 21-50 amps, and 51-100 amps.

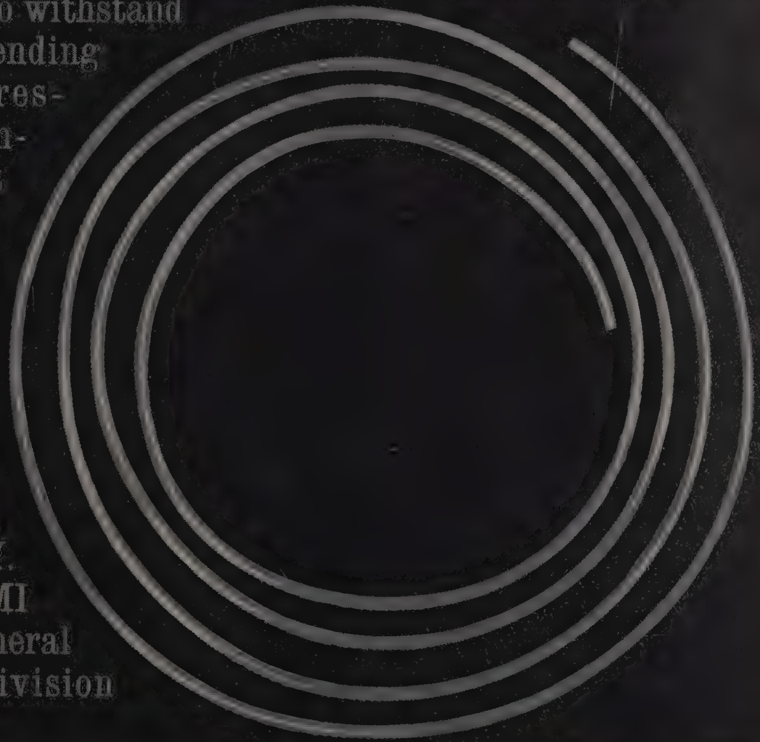
The NYBFU covers the vast majority of electrical inspections in the State of New York, and their action concerning N-I circuit breakers is a pattern similar to that being followed by a number of eastern inspection authorities.

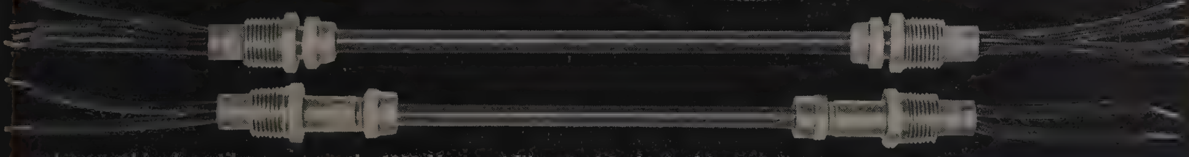
Chicago Contractors Push Separate Bid Plan

Mechanical specialty contractors in Chicago are planning to give bid-shopping and bid-peddling a rough time. For years, these twin-evils of the single contract method of bidding building construction work have been a thorn in the side

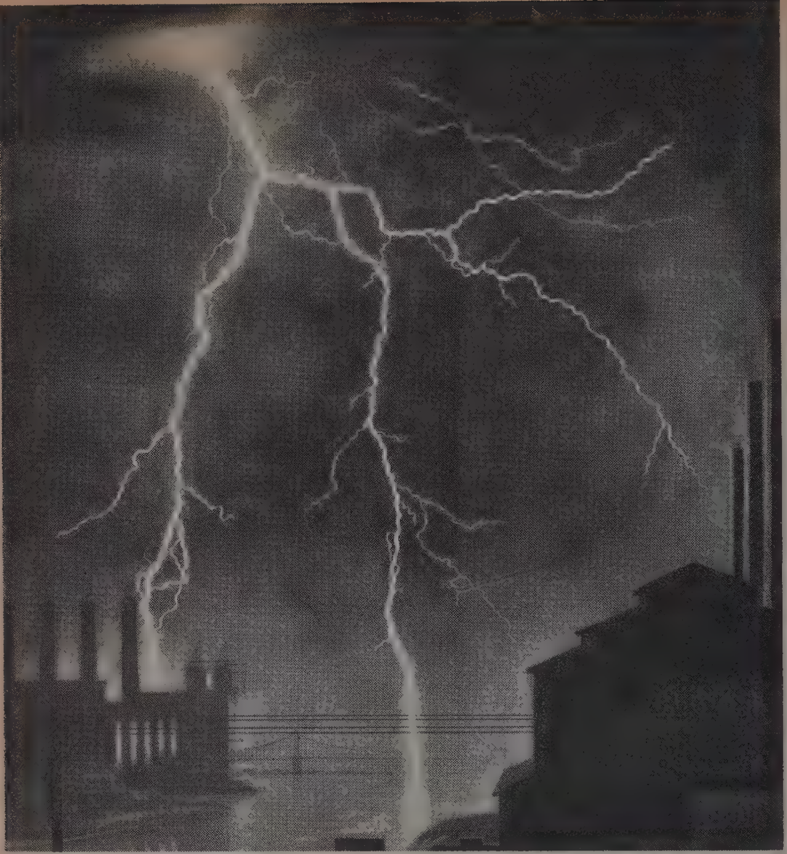
Safety Mineral Insulated Cable for a greater variety of 600 v applications than any other wiring system*

MI Water Resistance: Impervious to water, steam, oils and solvents, MI is ideally suited for installations where these factors cause ordinary cables to break down. MI has helped eliminate costly shutdowns in dairies and food processing plants where washdowns are a daily function. **MI Heat Resistance:** Unlike any other cable system, the limiting factor for MI heat exposure is the copper components of the cable. The magnesium oxide insulation is heat-stable until well over twice the melting point of copper (1083C). With an MI system as opposed to conduit there is no need for circuitous routing to avoid contact with boilers, machines and other sources of heat. Cable operating temperature is 250C, but standard general application (Type O) and hazardous areas (Type H) seals are limited to 85C. **MI Flexibility:** No need for factory-made conduit bends... MI can be hand formed on the job and easily clipped into position. MI is able to withstand severe twisting, bending and deforming pressures because the conductors cannot shift within the highly compressed magnesium oxide insulation. For a copy of our new MI catalog, write **General Cable Corporation,** 730 Third Avenue, New York 17, N.Y. Manufacturers of MI Cable since 1941. Mineral Insulated Cable Division





*Approved for hazardous areas in the 1959 National Electrical Code, Articles 330, 501, 502 and 503.



WILL YOUR "GROUNDS" CARRY IT?

During seasons of electrical storms, a careful program of checking all ground connections may save your company serious outages and property damage. Nine tenths of industrial lightning damage is reported to be on vital electrical equipment—motors, generators, transformers. Experience shows that ground resistance does not remain constant. Tests should be made at least once a year, and high ground resistance corrected.

Do You Have This Information File on Grounding?

The James G. Biddle Co. File 25 is an excellent fund of information on grounding problems. It includes a Manual on Ground Resistance Testing, and Bulletins on "Grounding Electric Circuits Effectively" and "Grounding Principles and Practices Applied to Industrial Plants."

USE THE MEGGER® GROUND TESTER

To test ground connections, the easiest, quickest, and most dependable method is the use of the Megger Ground Tester with its own hand generator for current supply. Reading the resistance value is as easy as reading a voltmeter—directly in ohms. Only *one set of connections, one operation, without any calculations.* Each instrument is self-contained, rugged, and portable. Its cost is a small fraction of the savings resulting from adequate grounding protection.

Write for Ground Testing File 25-ECM.

B1010

BIDDLE INSTRUMENTS

JAMES G. BIDDLE CO.

Electrical & Speed Measuring Instruments

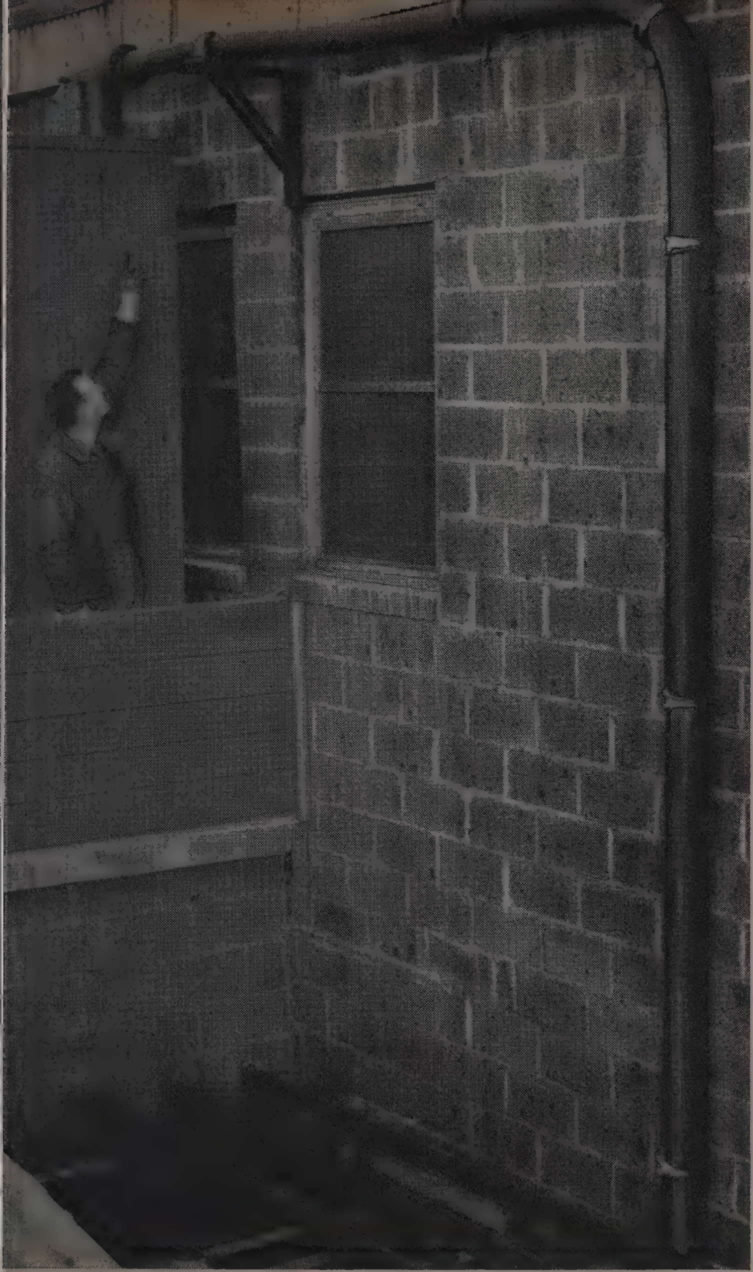
1315 ARCH STREET • PHILADELPHIA 7, PA.

SPEAKERS on Utility day at the convention of the New York State Association of Electrical Contractors and Dealers, Inc., held at Whiteface Inn were C. W. Meytrott, vice president, Consolidated Edison Company of New York, Inc., N. Y.; W. A. Lyons, vice president, New York State Electric and Gas Corporation, Binghamton, N. Y.; A. C. Sugden, engineering manager, Long Island Lighting Co., Mineola, N. Y.; and J. E. Doolittle, vice president, Central Hudson Gas and Electric Corp., Poughkeepsie, N. Y.

of the mechanical contracting industry. With the progressive increase in size, complexity and cost of mechanical work, these practices have become much more serious. Reputable sources indicate that it is now possible for a bid-shopping general contractor to "auction off" from 40% to 70% of the total building construction cost to bid-peddling mechanical subcontractors. This compares to what was once a 10% to 15% slice of building costs.

Building owners seldom, if ever, benefit from the auction savings which generally accrue to the prime contractor and may end up with inferior workmanship and materials as a result of the economic squeeze on the successful bid-peddling subcontractors. On top of that, prime contractors may add a "handling charge" to the cost of each subcontract negotiated in addition to a justifiable coordinating fee.

This is the gist of the single-bid evils contained in a preface to the Chicago Plan for Separate Mechanical Specialty Contracting Bids. It was developed and approved after three years of intensive study and survey by the Coordinating Committee of Mechanical Specialty Contractors Associations of Chicago (electrical, mechanical, plumbing, ventilating and air conditioning). A questionnaire survey of architects in the Chicago area about two years ago received an extraordinary 48% response. A significant 71% of the architects replying favored



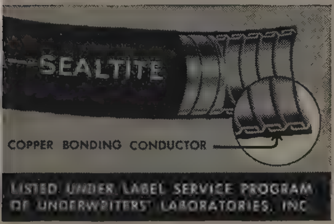
4″ Sealtite flexible, liquid-tight conduit guards plant's main power supply

At the Thatcher Glass Manufacturing Co. in Elmira, N. Y., Sealtite conduit protects wires carrying the plant's 6600 v, three-phase power supply between the air circuit breaker and two banks of distribution transformers. The 40-foot length of 4″ I.D. Sealtite being liquid tight protects the wiring from the elements — being flexible, it greatly simplifies installation.

For even the roughest day-in, day-out weather doesn't faze this flexible, liquid-tight conduit. The tough, extruded polyvinyl jacket proves itself in arctic cold and tropical heat. It resists moisture, dirt — even salt spray and corrosive chemical fumes. Its flexibility absorbs vibration. These are some of the reasons why Sealtite often outlasts rigid conduit — why you should use it the next time you need the utmost in wiring protection.

WHERE TO GET SEALTITE — Electrical Wholesalers stock Types U.A. and E.F. Sealtite in easy-to-handle coils, in black or gray. Be certain you ask for and get the quality conduit marked "Sealtite" and "Anaconda" on the cover. Buy it in long lengths on reels or in cartons and cut it on the job without waste. Your wholesaler also stocks liquid-tight connectors. Free Booklet S-542 gives full information on Sealtite. Write: Anaconda Metal Hose Division, The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont. Sealtite is approved by Canadian Standards Association.

60138


SEALTITE
COPPER BONDING CONDUCTOR
LISTED UNDER LABEL SERVICE PROGRAM OF UNDERWRITERS' LABORATORIES, INC

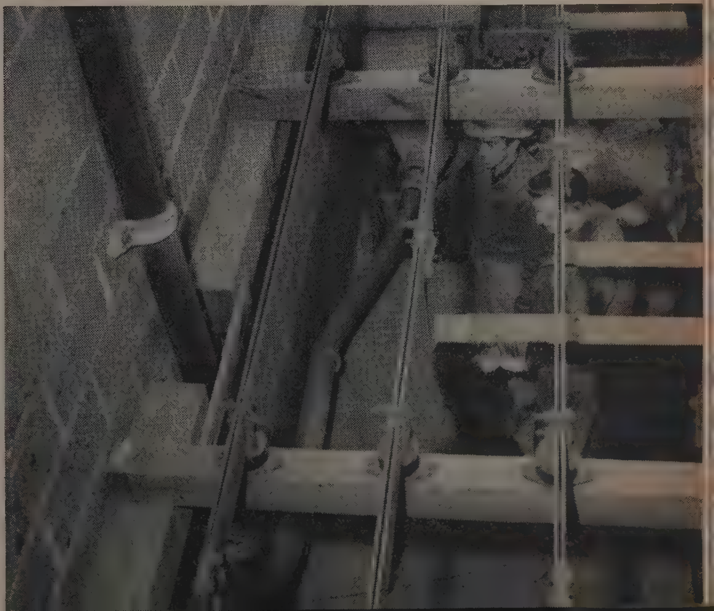
CUTAWAY SECTION of Type U. A. Sealtite shows tough polyvinyl chloride jacket over flexible metal core. Copper conductor wound spirally inside conduit provides positive ground.

Insist on the conduit marked

SEALTITE®

FLEXIBLE, LIQUID-TIGHT CONDUIT

an ANACONDA® product



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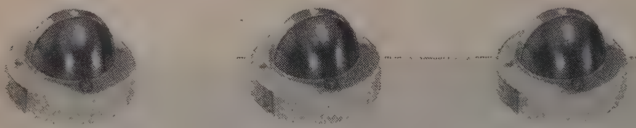
Cash in now with Kidde equipment!

For years, schools, public buildings, businesses and homes have been waiting for an inexpensive, dependable fire detection system approved by U.L. and F.M. Now you can sell them this vital detection system at a reasonable price. When you sell a Kidde fire detection system and install it yourself, there are thousands of dollars in potential profits for you.

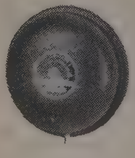
And, selling Kidde, you can be sure that you're selling quality. For more than 30 years, Kidde has been the leader in fire safety. It's a name you and your customers can trust!

Find out more about Kidde fire detection components—and how you can use them to cash in on these most profitable markets! For more details, write Kidde today.

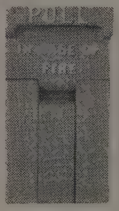


Kidde Fyrindex detectors. Self-resetting, fast-acting, easy to install. Fixed-temperature units each protect up to 225 sq. ft. Rate-of-temperature-rise models protect to 900 sq. ft. Combination rate-of-rise, fixed-temperature units each protect 2500 square feet. All U.L. and/or F.M. approved.

Control, rectifier, zone annunciator panels contained in one cabinet. Monitors up to ten zones. 12 or 24 v., dc.



Kidde weatherproof alarm bells — 6", 8", and 10" diameter. U.L.-approved.



Manual alarm pull for one or more stations.

Kidde

Kidde Ultrasonic & Detection Alarms, Inc.
985 Brighton Road, Clifton, New Jersey

A Subsidiary of Walter Kidde & Company, Inc., Belleville 9, N. J.

PENNSYLVANIANS attending NISA's annual convention in Miami Beach early in May were (l to r): Ralph Kufen, Kufen Electric Motors, Warminster, Pa.; John H. Boyer, General Electrical Service Co., Inc., Harrisburg, Pa.; and George McDaniels, Kufen Electric Motors, Warminster, Pa.

separate bids and nearly half of them added their own comments about bidding procedures in the building construction industry. And the Committee notes that many general contractors, individually if not collectively, have come to realize that there is considerable merit in bid separation from the standpoint of the general contractor.

The Chicago Plan

Chicago's bid-separation plan is simple and straight-forward. It recommends the following five-step bidding procedure:

1. Preparation of separate-specifications for each of these four categories of mechanical specialty work:
   a. Plumbing and sewerage.
   b. Heating, piping, refrigeration and automatic temperature control systems.
   c. Ventilation and distribution systems for conditioned air.
   d. Electrical installations.
2. Taking of separate bids from reputable contractors on each of these four classes of work.
3. Letting of separate contracts to the low bidder, if qualified, in each category.
4. Provision for optional assignment of mechanical specialty contracts.
5. Stipulation of direct payments to mechanical specialty contractors, in the event these contracts are assigned.

The optional assignment recommendation covers those instances where it may be preferable to place all coordination and supervision under the general contractor. Then the mechanical contracts, after they have been awarded, would be assigned to the general contractor. If this is contemplated, the original

Meet a new kind of fluorescent fixture. Its name: *Corona.* You'll find it specified by architects and engineers wherever there is call for a fixture that is decorative as well as functional. A finely crafted walnut frame surrounds the diffusing pane, while birch baffles cut a pleasing modular pattern across its surface. The effect is warm...friendly...informal. Although contemporary in styling, *Corona* is completely harmonious with traditional interiors, both residential and commercial. Optically, it is all that you might expect in a fine lighting instrument engineered by Lightolier. Surface or stem mounted, in four sizes: 54″ x 54″, 30″ x 30″, 32″ x 54″, 16″ x 54″.

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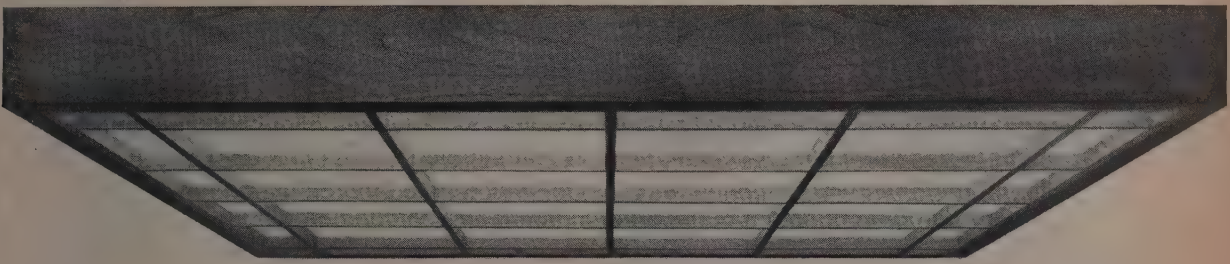

To learn more about Corona and other surface and pendant fixtures, write today for a complete brochure to Dept. EC9

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USE DIAMOND
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Where holding power counts . . . use this expansive anchor . . . for all kinds of masonry

- Nail Type
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Forged Aluminum Anchor and Hot Galvanized Nail Assembly. Size range: 3/16" to 1/2" dia. — 7/8" to 3½" length.

Only 3 steps to install in 20 seconds, 3/16" x 7/8" size

TRIAL OFFER: Write for catalog sheet and trial samples.

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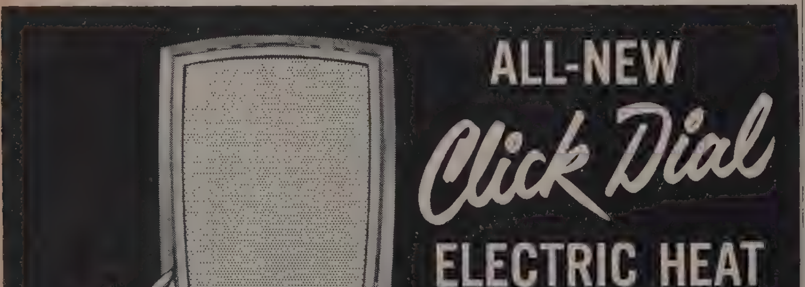
[illegible], NEW JERSEY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ELECTRIC HEAT
THERMOSTAT

for better control of electric heat

Here's a thermostat that responds *faster* to both convective and radiant heat. And, it gives more convenience in setting room temperature accurately. As the large dial is turned, each "click" is a change of *one degree!* You'll like it, too, for its easier wiring, faster installation. Write for Bulletin 3205 . . . it's free.

PENN CONTROLS, INC. Goshen, Indiana
EXPORT DIVISION: 27 E. 38th ST., NEW YORK, N.Y.
AUTOMATIC CONTROLS FOR HEATING, REFRIGERATION, AIR CONDITIONING, APPLIANCES, PUMPS, AIR COMPRESSORS, ENGINES

specification and bid form would provide for a specific, definitive amount for a supervision-coordination fee.

The Chicago Plan already is incorporated in "The Illinois Purchasing Act." An amendment signed into law July 24, 1959 requires separate specifications and bids for the four categories noted above on all State building construction where the estimated entire cost exceeds $25,000.

It is the firm conviction of the Mechanical Specialty Contractors Coordinating Committee that the Chicago Plan can appreciably cut construction costs and eliminate bid-shopping, bid-peddling, broker-contractors, and uncontrolled and unwarranted "private auction" of subcontracting work. To that end, they are promoting its application to all building construction work, public and private, seeking the cooperation and support of every architect, consulting engineer, owner and legitimate general contractor. A brochure explaining the plan and its advantages is being widely circulated among bidding authorities and interested general contractors. Should anticipated support be lacking, the subcontractor group vows to continue alone in its battle for fair bidding practices.

The Coordinating Committee of Mechanical Specialty Contractors Associations of Chicago, authors and sponsors of the Chicago Plan, represent the Electrical Contractors Association of City of Chicago, Mechanical Contractors Chicago Association, Plumbing Contractors Association of Chicago, and the Ventilating and Air Conditioning Contractors Association of Chicago.

Drucker Teaches CCECA Estimating Course

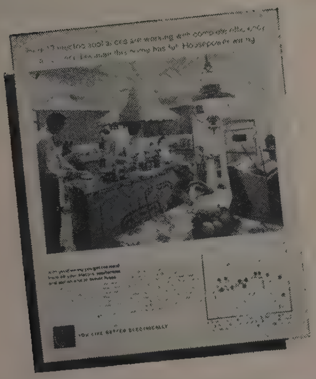
Among the services offered members of the Cook County Electrical Contractors Association, Chicago, is an electrical estimating course. For the past decade these courses have been run on an approximate annual basis with 8 consecutive weekly sessions of three hours each. General format includes lecture, round-table discussion and workshop techniques. Course enrollment normally is limited to 30 people to permit greater latitude in individual help and attention when needed.

Instructor for the 1960 Course

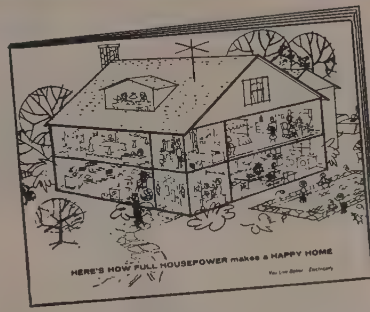
Put the Earning Power of
HOUSEPOWER
to work for you NOW

More people than ever *need* full Housepower . . . more people than ever *want* full Housepower . . . and this fall more people than ever are being told *how to get* full Housepower—from *you.*

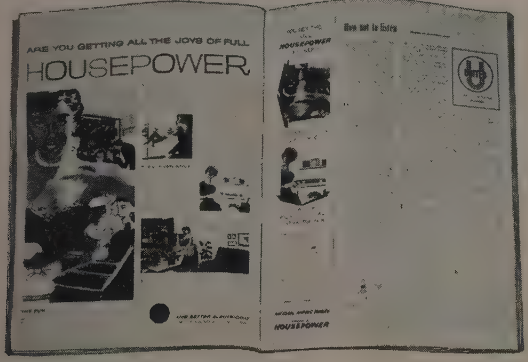
Plan right now to get your fall sales program underway. Here are the elements that are going to help you make more profits.



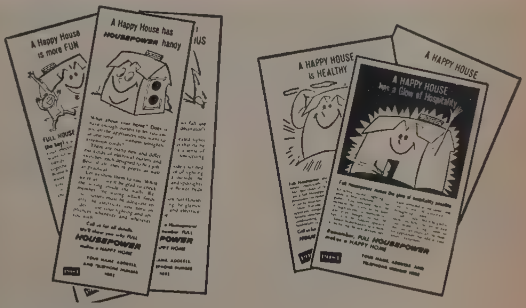
This ad in *The Saturday Evening Post* shows housewives how they can operate a dozen appliances at one time when they have full Housepower.


HERE'S HOW FULL HOUSEPOWER makes a HAPPY HOME

A brand new colorful booklet for your customers features the specialty devices and fixtures which put the earning power in Housepower for you. Ideal as a sales aid on the job—or for mailing to customers. 16 pages. Order your supply now. Free copy on request.


ARE YOU GETTING ALL THE JOYS OF FULL HOUSEPOWER

Two full color ads, sponsored by Edison Electric Institute, are appearing in *Better Homes & Gardens.* In the October issue, the National Wiring Bureau will run a one-column adjacent ad telling readers that the way to get full Housepower is to call *you.*


A Happy House is more FUN
A Happy House has HOUSEPOWER handy
A HAPPY HOUSE is HEALTHY
A HAPPY HOUSE has a Glow of Hospitality

The "Happy Home" idea is carried through in a series of ad mats to help you launch your sales program . . . and keep it going. Your name, address and phone number are all you have to add. Order now. Or write for free proof sheet showing mats in their actual size.

NATIONAL WIRING BUREAU

. . . a sponsor of

HOUSEPOWER

National Wiring Bureau
155 East 44th Street, New York 17, New York

☐ Please send me______copies of the new sales-making booklet titled "FULL HOUSEPOWER MAKES A HAPPY HOME." Cost: $9.00 per 100. Cat. No. A-4.

☐ Please send me______sets of the "Happy Home" ad mat series, six ad mats to the set. Cost $2.50 per set. Cat. No. M-1200.

☐ My check for $______is enclosed. ☐ Please bill me.

Name____________________

Organization____________________

Street____________________

City__________Zone______State______

EC&M 1060

SHERMAN TERMINAL LUGS AND CRIMPING TOOLS

SPEED INSTALLATION — REDUCE COSTS!

MONEY SAVER
SAVE UP TO 15%
WITH SHERMAN
Write for FREE Sample

SHERMAN HAND CRIMPING TOOLS
Portable or bench mounted for fast, easy installation of money-saving Sherman terminal lugs.

H. B. SHERMAN MANUFACTURING CO., BATTLE CREEK, MICHIGAN

FOR LONGER PROFITS . . .
buy quality lighting fixtures direct from factory

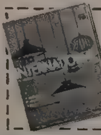
You can make more profit on lighting fixtures with the 'Site Saver' line. Sold direct, the low prices of these fixtures enables you to beat local and mail order competition...and still make a longer profit.

All fixtures absolutely guaranteed to meet with your approval. We certify highest quality and finest workmanship because . . . we make every item in the line . . . from glass bending and decorating to metal fabrication and finishing.

Here's the largest, most complete selection of fluorescent and incandescent fixtures offered by one manufacturer. Buying from one source saves you time and trouble. And you increase profits with 'Site Saver' lighting fixtures.

WRITE FOR FREE CATALOG
UNION WIRED, AFL-IBEW LABEL

INTERNATIONAL LIGHTING, INC. • 1825 N. 19th St., St. Louis 6, Mo.
DESIGNERS • MANUFACTURERS • MAin 1-0600



INSTRUCTOR DRUCKER reverts to a blackboard session to teach CCECA contractors the fine points of estimating fire alarm system work for existing buildings. Basic estimating course covered eight weekly three-hour classes in Chicago.

was Irv Drucker, an electrical consultant and engineer-estimator for Brown Electric Service in Chicago. Under his tutelage some 30 "students" learned the fundamental mechanics of estimating. Drucker's course material covered such subjects as: take-off techniques and estimating methods; contractor costs, markup, overhead, productive labor; development, use and breakdown of labor units; development of unit prices; mechanics of estimating medium industrial projects; estimating work in existing structures, revision work, exit signs and fire alarm systems.

General student concensus at the completion of the course was that the time and registration fees were well spent. All agreed they gained a broader concept of the art of estimating; felt they were better prepared for their daily chores; wanted

CONCENTRATING on instructor's advice during Cook County Electrical Contractors Association Estimating Course are Kurt Arntzen, Arntzen Electric Co., Chicago; and Louis Palacios, Johnson Electric Co., Des Plaines, Ill.

YOU ASKED FOR IT—

Construction and Maintenance now in a
handsome hard-cover book.

CONSTRUCTING ELECTRICAL SYSTEMS

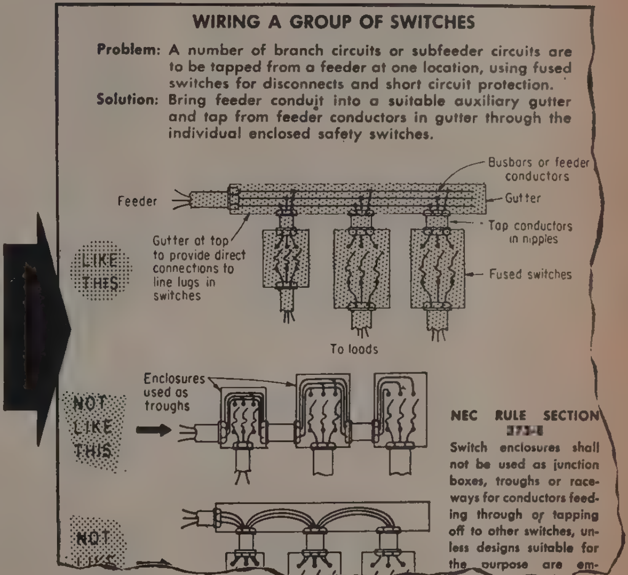
by J. F. McPartland and the Editors of Electrical Construction and Maintenance

Here's a modern, comprehensive reference and instruction manual on the methods and techniques used in constructing systems for power, light, signals and communications. Covering the best practice on selecting, mounting, connecting and housing all types of electrical equipment, **this manual presents *1959 National Electrical Code data* relating to installation. And a wealth of special illustrations are used throughout to clarify fine code points.**

Chapters are broken down on the basis of types of equipment to facilitate ready reference: lighting equipment — motors and controllers — conductors — raceways — switches — overcurrent protective devices — switchboards and panelboards — transformers — capacitors and regulators — power sources — high voltage — signals and communications.

CONTRACTORS — Get copies of this book for your job superintendents, foremen and estimators. They'll appreciate the gesture and you'll get a high return on your investment.

ENGINEERS — This book is a bonanza of information in the area where electrical design encounters most difficulty. Get copies for your key designers, junior engineers and draftsmen working into design.



WIRING A GROUP OF SWITCHES

Problem: A number of branch circuits or subfeeder circuits are to be tapped from a feeder at one location, using fused switches for disconnects and short circuit protection.

Solution: Bring feeder conduit into a suitable auxiliary gutter and tap from feeder conductors in gutter through the individual enclosed safety switches.

LIKE THIS
Feeder
Gutter at top to provide direct connections to line lugs in switches
Busbars or feeder conductors
Gutter
Tap conductors in nipples
Fused switches
To loads
NOT LIKE THIS
Enclosures used as troughs
NOT LIKE

NEC RULE SECTION 373-8

Switch enclosures shall not be used as junction boxes, troughs or raceways for conductors feeding through or tapping off to other switches, unless designs suitable for the purpose are em-

PLANT ELECTRICAL PEOPLE — This book should be in the reference library of plant electrical engineers, electrical supervisors and electricians.

ELECTRICAL INSPECTORS — Here's a unique presentation of code rules in combination with specific installation details taken from modern practice. The correlation between code generalities and actual job specifics will assist inspectors in many difficult rulings.

CONTENTS

General Considerations
Luminaires and
  Lighting Equipment
Motors and Controllers
Conductors
Raceways
Switches
Overcurrent
  Protective Devices
Switchboards
  and Panelboards
Transformers
Capacitors and Regulators
Power Sources
High Voltage
Signals & Communications

USE THIS COUPON TO ORDER YOUR BOOK

PLEASE PRINT

"CONSTRUCTING ELECTRICAL SYSTEMS"
Electrical Construction and Maintenance
330 West 42nd Street, New York 36, N.Y.

Please send me ____ copy (copies) of the book, "Constructing Electrical Systems," at $4.50 each.

☐ Payment enclosed. ☐ Please bill me. ☐ Bill Company.

Ship to:
Name________________ Title________________
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Please indicate nature of Co. business________________

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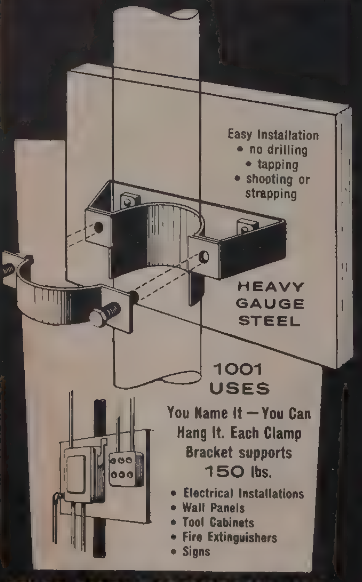
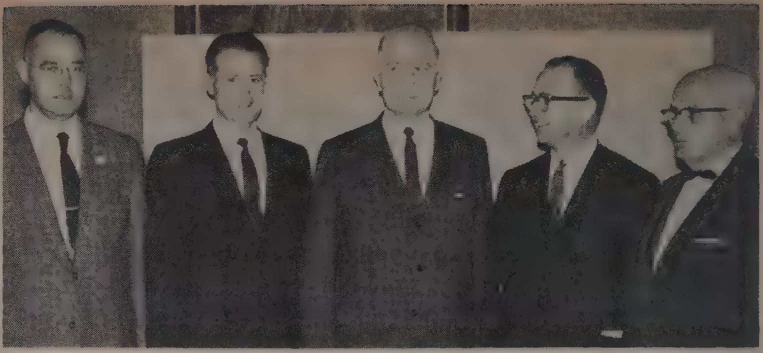
25th St. & 3rd Ave., Brooklyn 32, N.Y.

PUT LALLY COLUMNS TO WORK FOR YOU!
"Jiffy On" ATLAS CLAMP BRACKET



ATLAS METAL INDUSTRIES, INC.
Phone TU 8-3411
259 W. 23rd Street Hialeah, Florida



THEME for the last meeting of the New York Section, IES, was "What Good Lighting Does for My Industry," which was answered by three separate speakers, each representing a different segment of the lighting industry. Gene Rae (2nd from left), Holophane Co., Inc., represented lighting equipment manufacturers for NEMA, and discussed the part good lighting plays in the lives and activities of people, and how manufacturers can thus contribute to the safety and comfort of people through new and improved designs. Barney Benning (center), Graybar Electric Co., Inc., represented NAED, and outlined the size and status of the lighting market, stressing the need for greater activity in relighting. Matt J. Sherwood, (2nd from right), National Electrical Contractors Association, Washington, D. C., represented NECA, and declared that electrical contractors are the KEY to more lighting sales, as they are already in daily contact with the prospects for good lighting. He also suggested that what is urgently needed are more good "lighting contractors," specialists in lighting design, sales, and installation. New York Section vice chairman Harold J. Peters is at left and William H. Keen, Section chairman, is at right.

more of the same. Based on this reaction, CCECA is thinking of sponsoring two courses in 1961. One would be on an elementary level for younger contractor personnel. The other would be on an advanced level for those who already have had the preliminary course.

Chicago Contractors Finance Training Program

Chicago electrical contractors have set up a special trust fund to defray the cost of the Electrical Apprenticeship and Training Program. Beginning July 4, 1960, all employers of Group "A" electricians represented by Local Union 134, IBEW, contribute an amount to the fund equal to ¼ of 1% of their productive labor payrolls.

The fund was established by means of an amendment to the Working Rules of a long-standing Agreement (1921) between the Electrical Contractors Association of City of Chicago and Local Union No. 134, International Brotherhood of Electrical Workers. Negotiation of the amendment was through the Electrical Joint Arbitration Board.

By definition, Productive Labor Payroll covers: All straight time wages paid to Group "A" journeymen and apprentices represented by Local 134 for all regular and overtime hours worked; also all wages paid to foremen, but not in excess of the established journeyman rate. Premium portion of wages paid for overtime hours worked is excluded.

Contractors are setting up separate liability accounts titled "Electrical Apprenticeship and Training Fund"; report and pay quarterly with special forms covering their already established Electrical Insurance Trustee Fund (for welfare purposes) and the new Training Fund (for educational purposes). The Electrical Insurance Trustee will be the Agency through which the new fund will be collected.

California Maintenance Group Names O. D. Land President

Industrial engineer Oswald D. Land, Bay Cities Floodlight and Electric Co., was inducted as 1960-61 president of the Electrical Maintenance Engineers Association on July 22nd, when members and guests convened at the Roger Young Auditorium in Los Angeles for an evening of combined business and entertainment. Installed to office with him were Urban Beh, consulting lighting engineer, as first vice president; Lloyd A. Gates, Department of Water & Power, second vice president; and William R. Paluska, from the consulting engineering firm of Albert C. Martin, as secretary-treasurer.

Members who will serve during the next three years on the association's Executive Committee include Richard B. Hatfield, So. California Edison Co.; John Horsburgh, Kaiser Steel Corp.; Norman E. Stone and King D. Christopher, Clark Controller Co. Elected as an associate member to serve a two-year term was Robert R. Proctor, Larson-Hogue Electric Co., while K. Lee Alvey, AiResearch Mfg. Co., and William A. Rinehart, Burton Equipment Co., were selected for one-year terms.

Retiring officers and committeemen who were honored at the July meeting included Charles M. Tabor of Larson-Hogue, president; Paul H. Henrichs, So. Calif. Edison, first vice president; Frank R. Tharp, Floodlight and Fluorescent Maintenance Co., second vice president; and Frank S. Miller, Robertshaw-Fulton Controls, Grayson Div.

Chairmen who will preside over local area activities during the coming season include Walter H. Wolf, Zamboni Electric, Harbor Area; Harry M. Wallace, Westinghouse Electric Corp., "Old Baldy" Area; Morey Sherwin, Magnavox Research Laboratories, San Fernando Valley Area; Floyd J. McNeill, Western Calif. Canners, Contra Costa County Area, and Donald Higgins, American Potash and Chemical Corp., Mojave Desert Area.

Insulation Manufacturers Form Association

The National Cellulose Insulation Manufacturers Association was formed on June 21 at a meeting in Chicago of prime manufacturers in the field. The primary objectives of the association will be to further the recognition, promotion and use of cellulose insulation materials and to establish product standards for the protection of the public and the association.

O. J. Fish of the Pal-O-Pak Insulation Co., Inc., Hartland, Wis., was elected president; Paul Birkmeier, Hagan Manufacturing Co., Delphos, Ohio, vice president; Jon Oren, Insul-Cell Manufacturing Co., Muncie, Ind., treasurer; Lloyd Wheeler, Forest-Wool Insulation Co., Marshall, Mich., secretary.

The address for the NCIMA is P. O. Box 66, Delphos, Ohio.

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- Economical all around
- Elastic compression absorbs shock, vibration
- Made without plastics: won't wilt with heat, crack from cold
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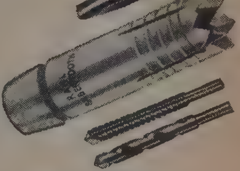

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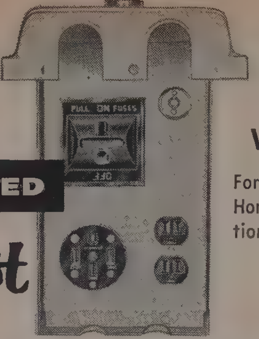


COMPLETELY WEATHERPROOF!

For Farms, Ranches, Mobile Home Parks, Outdoor Construction and Industry

100 DIFFERENT MODELS IN FUSED AND CIRCUIT BREAKER TYPES

MODEL P-55-F as illustrated has a 50 amp, 250 volt, 4 wire power receptacle, protected with a 2 pole, 60 amp pull out block. Also has a grounded type, duplex receptacle protected with a separate fuse. Top hub and three KO's in bottom facilitate overhead and underground connections.

COMPLETELY WEATHERPROOF!

Cover closes completely when in use and can be padlocked, to eliminate tampering. Also Circuit Breaker Model similar to model illustrated, with circuit breaker replacing the fuse. A complete line of standard models to choose from in fused or circuit breaker types with 15 to 60 amp, 3 and 4 wire receptacles.

SEE YOUR LOCAL ELECTRICAL DISTRIBUTOR OR WRITE FOR DETAILS!

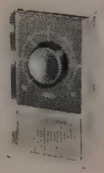
Midwest ELECTRIC PRODUCTS, INC.
DEPT. EC MANKATO, MINNESOTA

IN ELECTRIC HEAT THERMOSTATS... WHITE-RODGERS IS THE LEADER!

Use them with confidence—they're specifically designed for Electric Heat by White-Rodgers—world's largest maker.

Sold under the brand names of more than fifty manufacturers of quality electric heating equipment.

Type 1A61
World's Largest Seller



Type 1A65
Elegant New Companion

LIVE BETTER ELECTRICALLY

WHITE-RODGERS CO., ST. LOUIS 6, MISSOURI TORONTO 8, CANADA

NISA News

Several joint meetings of NISA chapters are scheduled to be held this fall:

- In San Francisco, members of the association's three California organizations, Northern California Chapter, Los Angeles Chapter and San Diego Chapter, will meet at the Hotel Jack Tar October 1.
- In Vancouver, B. C., members of the British Columbia, Oregon and Puget Sound chapters will meet October 21 at Grosvenor Hotel for the annual Pacific Northwest Conference.
- In Minneapolis, Minn., the Midwestern, North Central and Wisconsin chapters will hold the first "Tri-Chapter Conference" on September 16-17.

• • • •

Also on tap for the association's fall calendar: a "Management Seminar," conducted by the faculty of St. Louis University in St. Louis, probably in October; a third "Practical-Technical Seminar," featuring winding experiments and insulation test, probably in Ohio this month or next.

• • • •

Another big meeting: In Texas, the full conference of the Southwestern Chapter. Speakers include—

George C. Martin, Essex Wire Corp., "A Guide to the Selection of Magnet Wire"; Frank Beardslee, City of Austin, "Emergency Care of the Injured"; T. R. Warriner Jr., Warriner Hermetics Co., Fort Worth, Texas, "Practical Repair of Hermetic Refrigeration Units"; Connie H. Henry, Motor Rewinding Co., Dallas, Texas, "Morals, Money and Motors"; J. Arthur Turner Jr., NISA president.

• • • •

Two new brochures have been published by the association.

One, "Your New Emblem," describes the various materials available that incorporate the new EASA design. Electrotypes in various sizes and in one and two-colors; reproduction proofs, jewelry, truck and window decals, match books and other items formerly imprinted with the NISA emblem are now available and are described in the two-color leaflet.

The second brochure is a revision of a membership pamphlet and is entitled "We've Changed Our Name To Represent You Better." Testimonials from several EASA members in the United States and Can-

ELECTRICAL APPARATUS SERVICE ASSOCIATION

EASA

Founded as NISA in 1933

ada describe the various benefits for the independent electrical apparatus service shop of association membership.

Copies of these brochures are available without cost from association headquarters. Write Joseph M. Harrington, executive vice-president, National Industrial Service Association, Inc., 7730 Carondelet Avenue, St. Louis 5, Mo.

The new name of the association, Electrical Apparatus Service Association, Inc., becomes official April 1, 1961.

• • • •

The third quarterly meeting of the King Coal Chapter was held in St. Louis, July 22, at Henrici's Restaurant, Bel Air Motel Hotel. Eugene Baggot, Century Electric Co., described the differences between hermetic and conventional motors. Dee James and Robert McNamara of the local Insulation & Wires, Inc., office demonstrated silicone-rubber compound, plastic tubing and epoxy resin powder.

• • • •

Great Lakes Chapter's annual golf tournament was held September 8 at Warwick Hills Golf Club, Grand Blanc, Mich. Joseph F. Dudley, Dudley Electric Co., Flint, Mich., was host. The chapter's next meeting will be held in Ann Arbor, Michigan, with the Western Michigan Chapter, with the Hoover Ball and Bearing and the General Bearing Companies as hosts.

• • • •

The Rocky Mountain Chapter will hold its fall meeting in Albuquerque, N. M.

• • • •

Exhibit space for the 28th Annual Convention of the association—in San Francisco's Jack Tar Hotel, June 11-14, 1961—is being arranged by the association's national headquarters in St. Louis. Information and prices may be obtained by writing Mr. Harrington at the address given above.

SPOT LIGHT

For dramatic, glare-free accent-lighting in banks, libraries, schools, hospitals, specify Stonco's deep-contoured "Cone" bullet. Available fixed-focus or fully adjustable.

CLUSTER LIGHT

Smart, decorative cluster-lighting of hotels, motels, restaurants, residences with Stonco's crisp "Dart" bullet. Available in 2, 3 or 4 light clusters for wide-area illumination.

FLOOD LIGHT

Stores, office buildings, public areas are dramatically flood-lighted with Stonco's tapered "Flair" bullet. Available flush or stem-mounted to highlight merchandise, textures, colors.

...with STONCO cast aluminum outdoor bullets!

Don't let the styling of Stonco's new "Award Series" fool you. These are **outdoor** bullets. Solid cast aluminum. Completely weatherproof. "Air-Conditioned" for cooler, cleaner operation. The only truly decorative floodlights designed specifically for any outdoor application.

Write for Award Series catalog: LP-A.
See Sweet's Architectural file: 33a/ST.

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Cluster Lights • Power-Beams
Mercury Vapor • Vaportight
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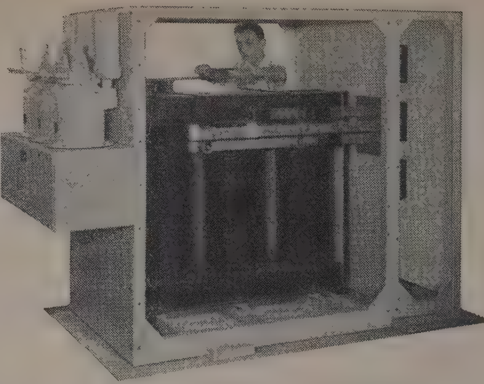
COMPUTER DESIGNED DRY-TYPE TRANSFORMERS

IMPROVED ACCURACY—
GREATER EFFICIENCY—
FASTER SERVICE—
REDUCED COST



Of the engineering design time normally required to prepare specifications for special transformer configurations, by far the greatest amount is used in computing the values of standard mathematical formulas. By using a properly programmed digital computer to calculate these values, LAND-AIR is able to greatly reduce the time required, improve the accuracy of the results, select the most efficient of many possible design variations, and take advantage of the most economical manufacturing techniques. For customers requiring transformers of special capacity or having features not found on transformers selected from standard catalogs, insertion of their particular specifications into the pre-programmed computer will produce a DRI-TRAN design having characteristics which meet those individual requirements.

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Please send complete information on Longyear Diamond Bits and Industrial Drills. Also the name of my nearest Longyear dealer.

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DATES AHEAD

International Association of Electrical Inspectors — Northwestern Section, Sheraton-Portland Hotel, Portland, Ore., September 12-14; **Southwestern Section,** Mapes Hotel, Reno, Nev., September 19-22; **Eastern Section,** Wentworth-By-The-Sea, Portsmouth, N. H., September 26-28; **Western Section,** Continental Hotel, Kansas City, Mo., October 3-5; **Southern Section,** Rice Hotel, Houston, Texas, October 17-19; **Canadian Section,** Toronto, Ont., Canada, Oct. 28-29.

NISA Chapter Meetings—North Central, Midwestern and Wisconsin, Minneapolis, Minn., September 16-17; **Central Ohio,** Columbus, Ohio, September 18; **Southwestern,** Austin, Texas, September 22-24; **Northern California, Los Angeles and San Diego,** Hotel Jack Tar, San Francisco, Calif., October 1; **King Coal,** Evansville, Ind., October 13, and Mount Vernon, Ill., January 12, 1961; **British Columbia, Oregon and Puget Sound,** Grosvenor Hotel, Vancouver, B. C., October 21.

The Ninth Annual National Symposium on Industrial Electronics—Symposium jointly sponsored by AIEE and IRE, Manger Hotel, Cleveland, Ohio, September 21-22.

Inter-Industry Farm Electric Utilization Council — National Electric Farm Power Conference, Kentucky Hotel, Louisville, Ky., Sept. 21-23.

International Association of Electrical Leagues—25th annual conference, Hotel President, Kansas City, Mo., October 5-7.

National Electronics Conference—Hotel Sherman, Chicago, Ill., October 10-12.

Florida Association of Electrical Contractors—Annual Convention and 8th Electrical Trade Show, Deauville Hotel, Miami Beach, Fla., October 12-15.

48th National Safety Congress—Annual convention of the National Safety Council, Conrad Hilton Hotel, Chicago, Ill., October 17-21.

National Electrical Contractors Association—1960 annual convention, Las Vegas Convention Center, Las Vegas, Nev., October 23-27.

American Standard Assn.—11th National Conference on Standards, Sheraton-McAlpin Hotel, New York City, October 25-27.

National Fire Protection Association—Fall Conference, Columbus, Ohio, November 14-16.

National Electrical Manufacturers Assn.—Annual meeting, Traymore Hotel, Atlantic City, N. J., November 14-18.

Electrical & Home Appliance Show—Electrical Building, Balboa Park, San Diego, Calif., November 25-30.

The Third National Conference on the Application of Electrical Insulation—Co-sponsored by the AIEE and NEMA, Conrad Hilton Hotel, Chicago, Ill., December 5-8.

Industrial Heating Equipment Association, Inc.—Dearborn Inn, Dearborn, Mich., January 23-24, 1961.

Plant Maintenance and Engineering Show—International Amphitheatre, Chicago, Ill., January 23-26.

Intermountain Electrical Association—Annual conference, Hotel Ben Lomond, Ogden, Utah, February 2.

Power & Communications Contractors Association—Annual convention, Sir Francis Drake Hotel, San Francisco, Calif., February 5-7.

National Electrical Week—National promotion, February 5-12.

National Rural Electric Cooperative Association—19th annual meeting, Dallas, Texas, February 13-16.

15th International Heating & Air-Conditioning Exposition—International Amphitheatre, Chicago, Ill., February 13-16.

Upper Midwest Electrical Industry Convention — Leamington Hotel, Minneapolis, Minn., February 19-22.

National Electric Sign Association—Convention, Benjamin Franklin Hotel, Philadelphia, Pa., February 19-22.

17th Annual National Wiring Sales Conference—Sherman Hotel, Chicago, Ill., February 23-24.

Edison Electric Institute — Annual sales conference, Edgewater Beach Hotel, Chicago, Ill., March 20-22.

Institute of Radio Engineers, Inc.—International Convention and Show, Waldorf-Astoria Hotel and New York Coliseum, New York City, March 20-23.

American Power Conference—Sherman Hotel, Chicago, Ill., March 21-23.

Nebraska Iowa Electrical Council—4th Biennial Nebraska Iowa Electric Trade Show, Peony Park Auditorium, Omaha, Neb., March 21-23.

Northern California Electrical Industry Show—Sponsored by the Electrical Maintenance Engineers' Association of Northern California, Brooks Hall, San Francisco, Calif., April 5-9.

Missouri Valley Electrical Association—Annual engineering conference, Hotel President and Municipal Auditorium, Kansas City, Mo., April 12-14.

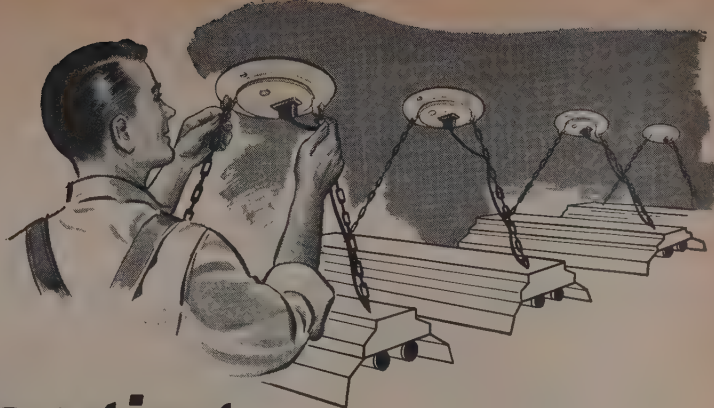
2nd Annual Alabama Electrical & Electronics Exposition—Birmingham Municipal Auditorium, Birmingham, Ala., April 17-19.

National Association of Electrical Distributors—53rd annual convention, Detroit, Mich., April 29-May 3.

Pacific Coast Electrical Association, Inc.—Annual convention, Sheraton-Palace Hotel, San Francisco, Calif., May 17-19.

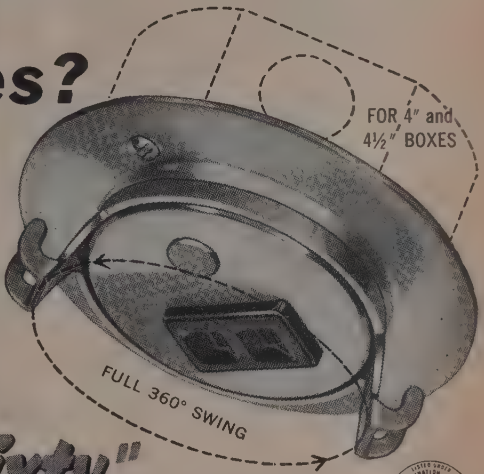
Edison Electric Institute—Annual convention, New York City, June 5-7.

Electrical Apparatus Service Association, Inc.—28th annual convention, Jack Tar Hotel, San Francisco, Calif., June 11-14.



Hanging Fixtures?

Just ATTACH . . . HANG . . . TWIST



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SIMPLE, EASY, SWIFT . . . screw hanger on box—forget alignment . . . hang fixture on small, compact arms . . . then, align fixture instantly with a twist of the wrist!

EXCLUSIVE FRICTION RING suspension rotates all the way around. 360°

10 RECEPTACLE CHOICES—one for every job—an Ideal exclusive.

BRIGHT CADMIUM PLATED for neat, attractive installations.

HANGING CAN BE DONE with 2 or 4 chains, or S hooks.

"LOW COST" HANGERS ALSO AVAILABLE
38° swing. Grounds fixtures to systems. 2 or 3-wire models. 2 5'-chains. Hooks and cord clips supplied.

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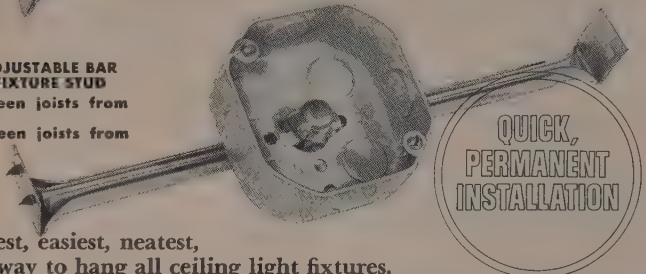
562 used between joists from 12" to 18"
563 used between joists from 18" to 26"

BLACKHAWK ADJUSTABLE BAR HANGER WITH FIXTURE STUD
560 used between joists from 12" to 18"
561 used between joists from 18" to 26"



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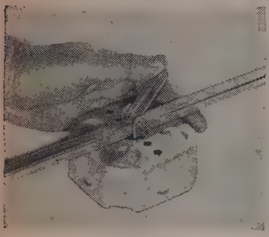

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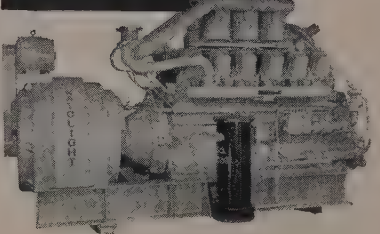

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Among the Manufacturers

Headquarters Announcements

The Gedney Electric Co. and **The Andrew Terry Co.** have been consolidated into the Gedney Electric Co., Inc., with corporate headquarters at Terryville, Conn. Officers are Dwight W. Pond, chairman of the board; Malcolm W. Heron, president; G. Philip Pond, executive vice president; and Charles W. Buell, secretary and treasurer.

Wellmade Metal Products Co., Oakland, Calif., announces the acquisition of the **Leadlight Fixture Co.,** to be known as the Leadlight Lighting Fixture Div., with Milton Kosman as sales manager.

Federal Pacific Electric Co., Newark, N. J., has acquired the **Pioneer Electric Ltd.,** Winnipeg, Canada.

Yale & Towne Mfg. Co., New York, N. Y.—Gordon Patterson, president and director.

Union Carbide Corp., New York, N. Y.—Howard S. Bunn, vice chairman of the board; Birny Mason, Jr., president.

Day-Brite Lighting, Inc., St. Louis, Mo.—James F. Whitehead, Jr., president.

Sylvania Electric Products Inc., New York, N. Y.—Arthur L. B. Richardson and George C. Connor, senior vice presidents; William F. Rueger, secretary.

Benjamin Div., Thomas Industries, Inc., Louisville, Ky. — Michael N. Flynn, sales manager.

International Rectifier Corp., El Segundo, Calif.—John D. Vickrey, sales manager, Selenium Products Div.

U. S. Industries, Inc., New York, N. Y. — Arnold P. Moran, vice president-treasurer; I. John Billera, executive vice president—operations.

Multi-Amp Electronic Corp., Union, N. J.—Ralph J. Dikeman, Jr., marketing manager.

The Euclid Electric & Mfg. Co., Cleveland, Ohio—Carl R. Roehrer, sales manager.

General Electric Co., Schenectady, N.Y.—Robert B. Kurtz, general manager, General Purpose Control Dept., Bloomington, Ill.

Daystrom, Inc., Murray Hill, N. J.—Edward J. Querner, vice president and general manager, Transicoil Div., Worcester, Pa.

U. S. Rubber Co., New York, N. Y.—J. J. Orr, director of engineering.

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Wolverine Tube, Allen Park, Mich.—Carl T. Fuller, manager of special product sales.

J. I. Case Co., Racine, Wis.—Carl vonLinsowe, director of engineering—Industrial products.

William Brand-Rex Div., American Enka Corp., Concord, Mass.—James D. Kelly, product sales manager, Dielectric materials.

Thomas & Betts Co., Elizabeth, N. J.—Edward F. Finn, product manager, Pos-E-Kon Div.

General Electric Co., Nela Park, Cleveland, Ohio—Robert V. Corning, manager—marketing, Large Lamp Dept.

Allis-Chalmers Mfg. Co., Milwaukee, Wis.—G. A. Saar, general manager, mechanical departments; W. M. Terry, Jr., general manager, electrical departments; Industrial Equipment Div.

Kraloy Plastic Pipe Co., Santa Ana, Calif.—Robert W. Allison, manager of advertising and public relations.

Clayton Mark & Co., Evanston, Ill.—James Oakley, director of manufacturing.

United Transformer Corp., New York, N. Y.—Samuel L. Baraf, president.

Black & Decker Mfg. Co., Towson, Md.—Robert D. Black, chairman of the board; Alonzo G. Decker, Jr., president; W. Griffin Morrel, executive vice president.

Carlon Products Corp., Aurora, Ohio—John I. Rudge, executive vice president—marketing.

General Electric Co., Plainville, Conn.—J. Edwin Godfrey, manager—OEM sales, Circuit Protective Devices Dept.

Palo Alto Engineering Co., Palo Alto, Calif.—John C. Beckett, general manager and chief engineer.

The Imperial Electric Co., Akron, Ohio—Robert J. Weesner, vice president, sales and engineering.

Fisher-Pierce Co., South Braintree, Mass.—Michael D. Dingman, sales manager.

International Resistance Co., Philadelphia, Pa.—George D. Butler, vice president.

Kaiser Industries Corp., Oakland, Calif.—George Havas, vice president and director of engineering.

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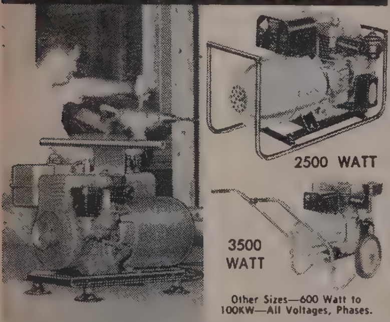

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I-T-E Circuit Breaker Co.: William D. Jameson, manager, Buffalo district sales office.

Weston Instruments Div., Daystrom, Inc.: Victor G. Kocenko, director of manufacturing, headquartered in Newark, N. J.

Stanley Electric Tools: Herbert J. Heller, district manager, New York City territory.

Boston Woven Hose & Rubber Co.: W. D. Gamble & Co., Pittsburgh, Pa., sales representative in West Virginia and western Pennsylvania.

Multi-Amp Electronic Corp.: E. J. Robinson Associates, Buffalo and Syracuse, N. Y., representative for up-state New York.

General Electric Co.: Richard R. Marvin, manager, Niagara Sales District, Large Lamp Dept., headquarters in Buffalo, N. Y.

SOUTH ATLANTIC

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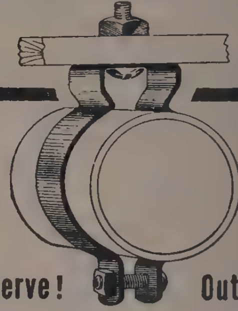

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Fisher-Pierce Co.: Dale P. Seyfried Co., Detroit, Mich., sales representative for Michigan.

Controls Co. of America: R. V. Hansen, eastern sale manager with headquarters in Schiller Park, Ill., Electron Div.

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Oliver Electrical Mfg. Co.: John C. Carroll, Jr., mid-west sales manager, headquarters in Chicago.

Halo Lighting Products, Inc.: William Johnson, Memphis, Tenn., representative.

National Carbon Co.: Fred B. O'Mara, vice president—production with headquarters in Cleveland.

Long-Lok Corp.: G & H Sales Co., Cincinnati, Ohio, sales representative for Kentucky, Ohio and Michigan.

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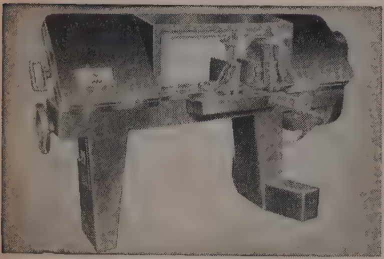

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Virden Lighting: Edwin S. Persons, representative for portions of Missouri, Illinois, Indiana and Kentucky, with headquarters in St. Louis.

Harvey Aluminum: Peabody Brothers, Dallas, Texas, sales representatives in Texas, Louisiana, Arkansas and Oklahoma.

Air Reduction Sales Co.: Blaine G. Harrington, manager of Kansas City district.

Pyle-National Co.: The Ralph Eads Co., Houston and Dallas, Texas, sales representative in Texas.

Graybar Electric Co.: F. B. Murray, manager at San Antonio, Texas.

Carol Cable Co.: Dupont-Bondurant, New Orleans, La., representative for Louisiana and Mississippi.

Westinghouse Electric Corp.: Earl G. Lindsey, works manager, lamp division plant in Little Rock, Ark.

WEST

International Rectifier Corp.: Eli Mitchell, western regional sales manager.

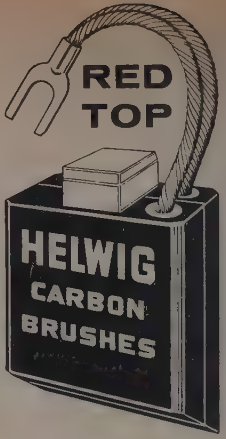
Daystrom, Inc.: Vernon Shelters, manager, Weston Instruments Div., Repair Service and Modification Center, Los Angeles, Calif.

Wolverine Tube: J. P. Moore, sales representative in San Francisco district with headquarters in Seattle, Wash.

Controls Co. of America: Jack Shnable, western sales manager, headquartered at El Segundo, Calif.

Multi-Amp Electronic Corp.: Wrathall & Krusi, San Francisco, Calif., representative.

Stanley Electric Tools: Robert A. Upson, district manager for western Montana, southern Idaho, Oregon, and southwestern Wash.



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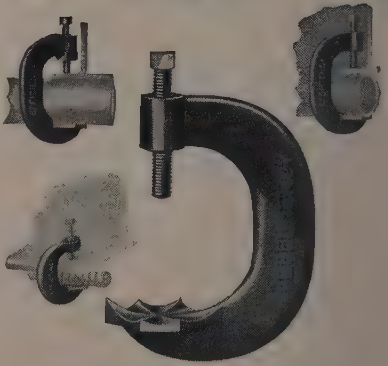

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ELECTRIC & MFG. CO.
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VOLTAGE DROP IN APARTMENT HOUSES

(FROM PAGE 106)

of the results of voltages higher than nameplate. But that this is by no means a subject to be neglected is well illustrated by the following excerpts from a well-known manufacturer's statement to us:

"In regard to voltages over 115 volts ac, radios and television receivers will require more frequent servicing. Our experience over the years leads us to believe that the life of the small vacuum tube is shortened when equipment is running on ac lines with input over 125 ac."

And from the same manufacturer:

"In regard to our air conditioners . . . A higher than 110% input voltage (i.e., 110% of 115 volts or 126.5 volts), can damage the protection relay employed in our units . . ." All manufacturers place a consistent limit of 125 to 126.5 volts on their equipment.

Let us consider the implications of these statements in regard to line voltage drops:

(1) We have already stated a fact which everyone knows—that the service supply voltage normally rises during off-peak periods. Our assumption of 123 volts is probably conservative, and the utilities can confirm that they have more trouble with over-voltage complaints than with under-voltage.

(2) Let us also remember that under off-peak conditions our peak feeder drop of 3½% may diminish to one or two volts, and with a 1% design to practically nothing.

(3) Under these conditions aren't we approaching the 125-126.5-volt limit too closely for comfort (with the 5-volt drop) and much too closely for safety with the 1% drop?

INDUSTRIAL GROWTH in Florida was discussed by John Sutcliffe (L), Sutcliffe's Electric Co., West Palm Beach, Fla., and H. E. "Ed" Grant, Tennessee Electric Motor Service, Nashville, Tenn., at recent NISA convention in Miami Beach.

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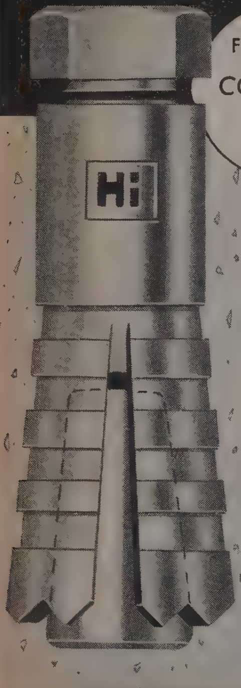

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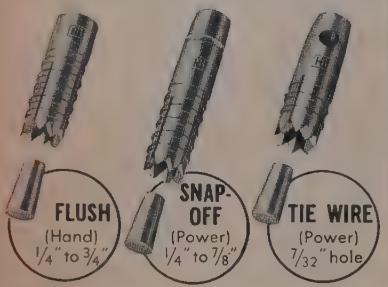

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442 ELM ST. • SYCAMORE ILL.

LUMINOUS DOME SOLVES GLARE PROBLEM

[FROM PAGE 109]

the centerline strong-back. For cleaning and relamping, this process is reversed, progressively pulling fixtures along cable supports until they can be reached from the surrounding crawlspace, then uncoupling, unsnapping and removing them until the job is completed.

As noted in an accompanying photo, end chassis in each row are fitted with longer flexible pigtails equipped with plugs that connect into duplex receptacle boxes mounted around the skylight rim. Boxes are connected to each other and to the master control panel by curved lengths of rigid conduit.

Aluminum Umbrella

The third major assignment was to create a large-area reflecting surface above the lamps, and this was accomplished by constructing a 45-ft-dia aluminum canopy or "umbrella" which was suspended approximately 2 ft above the lamps and supported by rod hangers attached to exterior roof purlins and hip beams.

Since aluminum sheeting used for the canopy was corrugated, interflection of light between lamps and skylight topside is effectively "scattered" to promote diffusion. Installation of the canopy also blocked out all natural light, thereby eliminating the wide variations between glare and gloom that previously were so objectionable. And finally, as added insurance against natural spill-light infiltration, the exterior clear-glass roof was painted a dark grey on the underside.

Results of the installation have been highly gratifying to all concerned, for the job was completed well within budget limitations; the obtained lighting intensity on working areas is now an even 50 fc; the aesthetic beauty has been enhanced; and a difficult maintenance problem has been solved.

This lighting installation is also unusual in that it was completely designed, promoted and installed by the electrical contractor, who developed the solution, assembled all supporting data, rendered the necessary installation drawings, and purchased all required materials. Sol Cohn of the California Supply Co., cooperated as consultant on fixture design.

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CONDUCTOR FILL IN RACEWAYS

[FROM PAGE 113]

At the bottom of Table C, the 50% area fill of a 1-in. conduit is given as 0.43 sq in. Therefore, the combinations in this example are well below the maximum permitted 50% fill (0.3378 sq in. represent about a 40% fill of a 1-in. conduit).

There may be occasions where rubber-covered conductors are preferred for rewiring an existing concealed conduit to the allowable 50% fill. In such instances, use the conductor dimensions given in Table A and the conduit percentage fills at the bottom of Table C.

While accompanying Tables A and C have been developed primarily for computing conduit sizes for different size conductors, the conductor dimensions given in these tables may be used to determine the size of other types of raceways.

For wireways, underfloor raceways and similar raceway systems, manufacturers provide appropriate tables for the number of conductors (T or R) permitted in each respective raceway size. Such tables are contained in each manufacturer's pamphlet describing the particular raceway. Because of the wide variety of raceway sizes other than conduits, it would not be possible to include such data in this article.

However, when the cross-sectional area of a particular raceway is known, Tables A and C may be used to determine any combination of R or T conductors that can occupy the raceway. For underfloor and cellular metal or concrete floor raceways, a 40% conductor fill is permitted. In wireways and auxiliary gutters, with minor exceptions, conductor fill cannot exceed 20% of the raceway cross-sectional area, and the number of wires is generally limited to 30.

In NEC Table 6, Chapter 9, representative values are given for lead-covered conductors. And NEC Table 7, Chapter 9 gives the dimensions for Type AVA, AVB and AVL conductors.

For any other type of conductor, the overall conductor cross-sectional area is determined by the formula:

$$CSA = D^2 \times 0.7854.$$

Where: CSA = cross-sectional area in sq in. of conductor and insulation; and D = cross-sectional diameter of conductor and insulation in inches.

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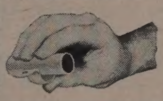

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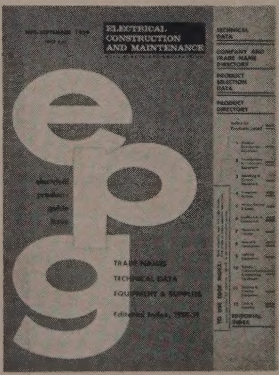

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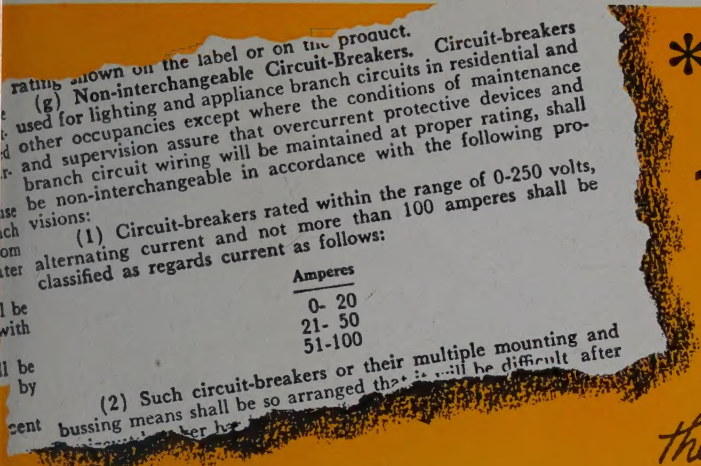
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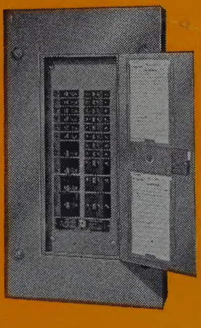

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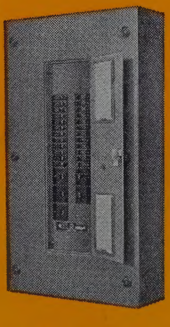

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